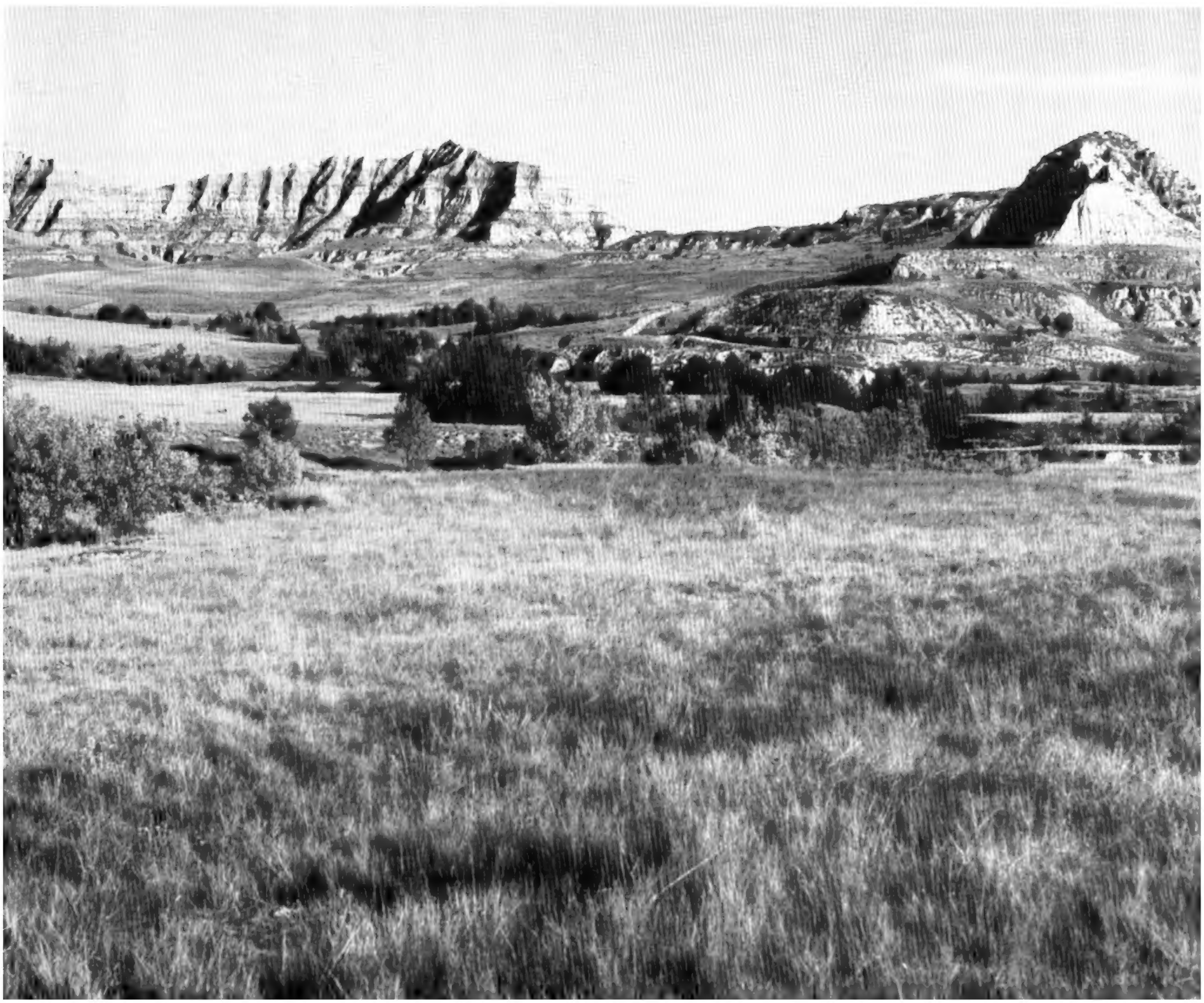
United States
Department of
Agriculture

Soil
Conservation
Service

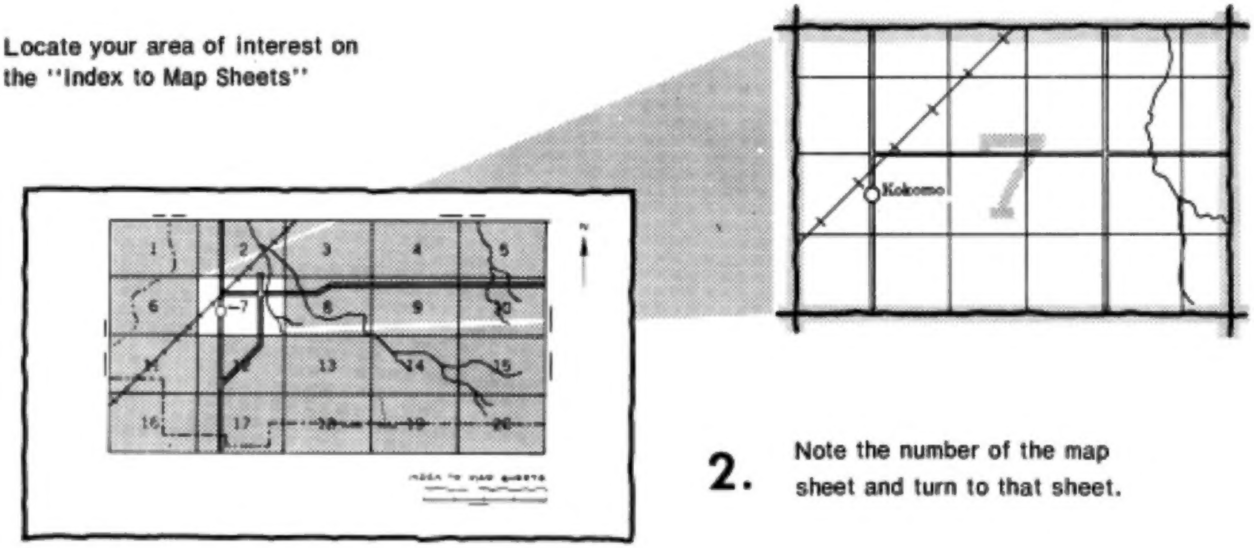
In cooperation with
North Dakota Agricultural
Experiment Station;
North Dakota Cooperative
Extension Service;
North Dakota State Soil
Conservation Committee;
United States Department of
Agriculture, Forest Service;
and United States Department
of the Interior,
Bureau of Land Management

Soil Survey of Golden Valley County North Dakota



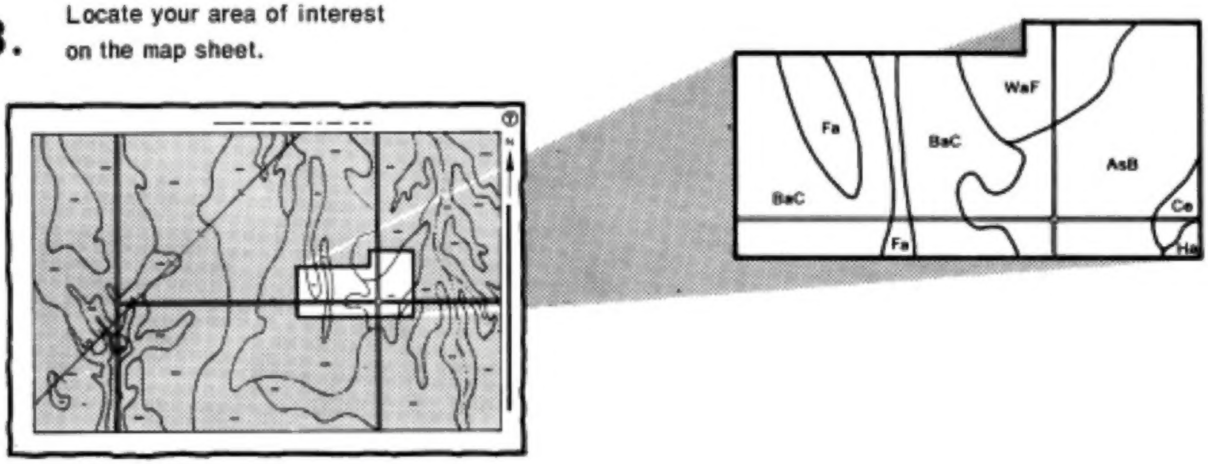
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

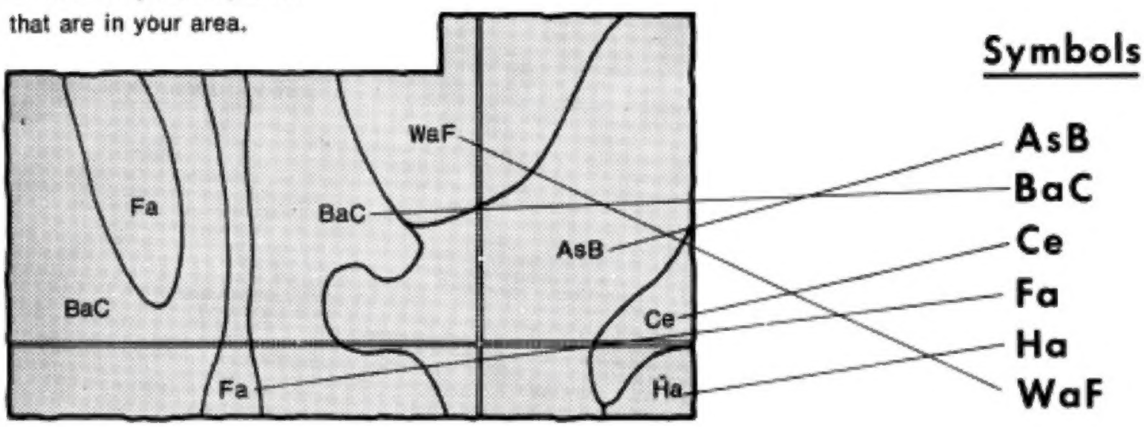


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

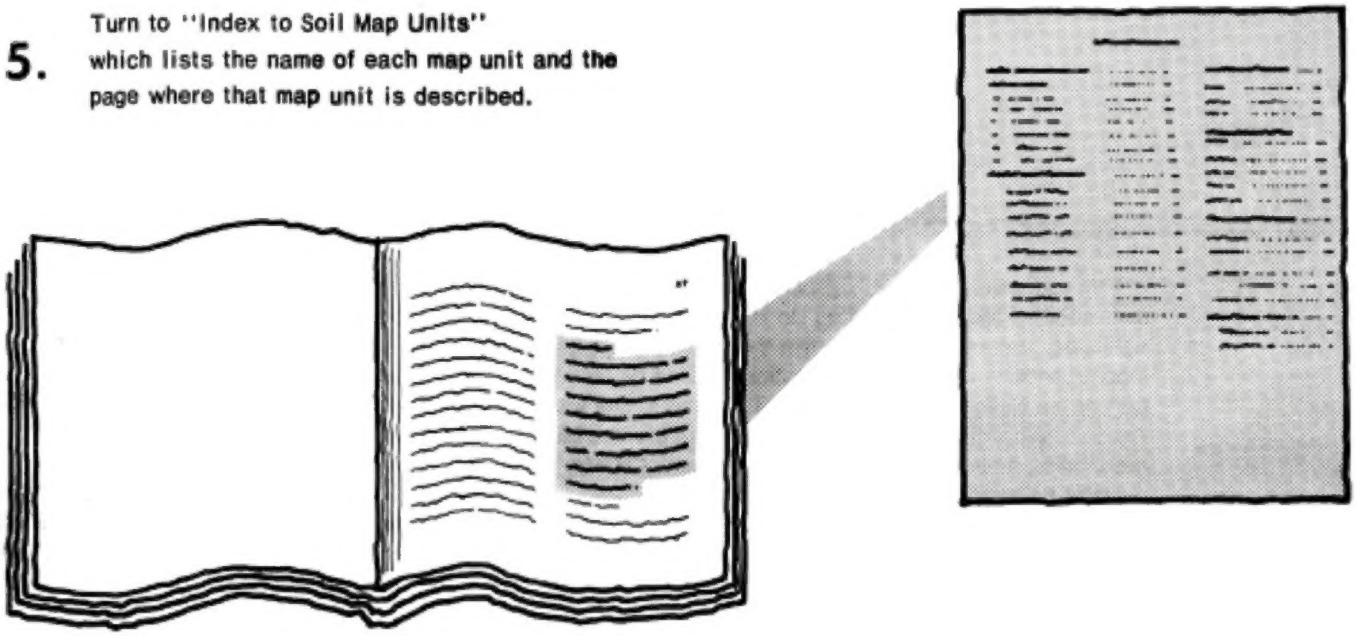


4. List the map unit symbols that are in your area.

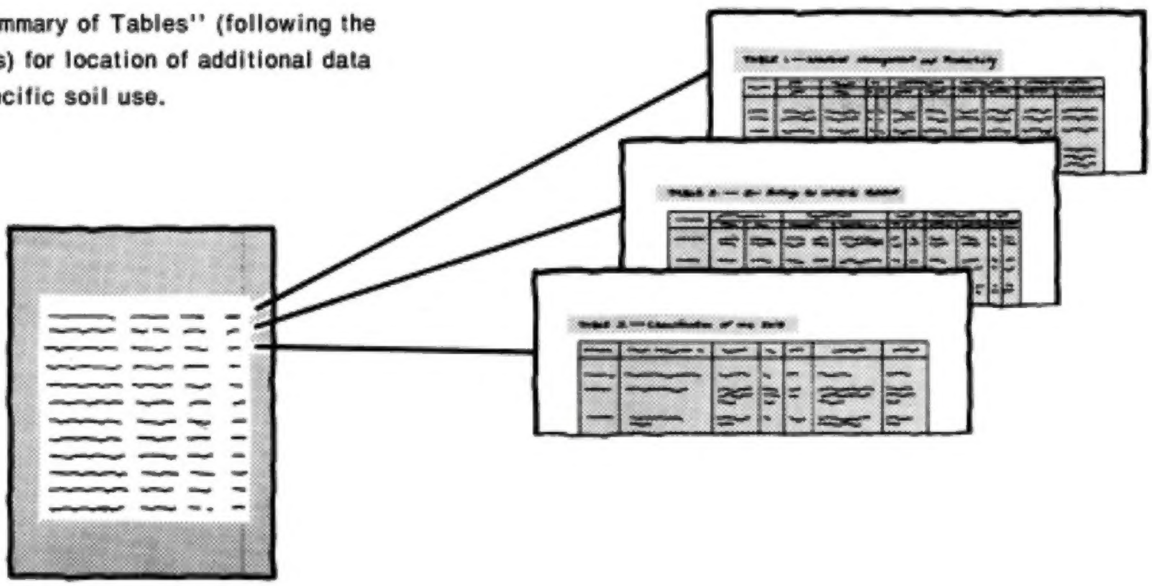


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1985. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, the Bureau of Land Management, the North Dakota Agricultural Experiment Station, the North Dakota Cooperative Extension Service, and the North Dakota State Soil Conservation Committee. Financial assistance was provided by the Golden Valley Board of Commissioners and the North Dakota Department of Universities and School Lands. The survey is part of the technical assistance furnished to the Golden Valley Soil Conservation District. The aerial photobase map on which the soils were delineated and published was flown in September 1976.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Cherry soils used for range in the foreground and Cabba soils and Badland in the background. The wooded drainageways provide diverse habitat for wildlife and protection for livestock.

Contents

Soil Series

Issued July 1989

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Golden Valley County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Ronnie L. Clark
State Conservationist
Soil Conservation Service

Soil Survey of
Golden Valley County, North Dakota

By Frederick P. Aziz, Soil Conservation Service

Fieldwork by Frederick P. Aziz, Kenneth W. Thompson, Ron Luethe, Robert Gilman, Lawrence E. Edland, and James Clapper, Soil Conservation Service, and Richard Kukowski, professional soil classifier, and Wilhelm Soil Consulting, Inc.

Map finishing by David W. Hickcox and Steve S. Kranich, North Dakota State Soil Conservation Committee

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
North Dakota Agricultural Experiment Station;
North Dakota Cooperative Extension Service;
North Dakota State Soil Conservation Committee;
United States Department of Agriculture, Forest Service; and
United States Department of the Interior, Bureau of Land Management

GOLDEN VALLEY COUNTY is in the west-central part of North Dakota (fig. 1). It has an area of 648,960 acres, or 1,014 square miles. Beach is the county seat. It is in the west-central part of the county.

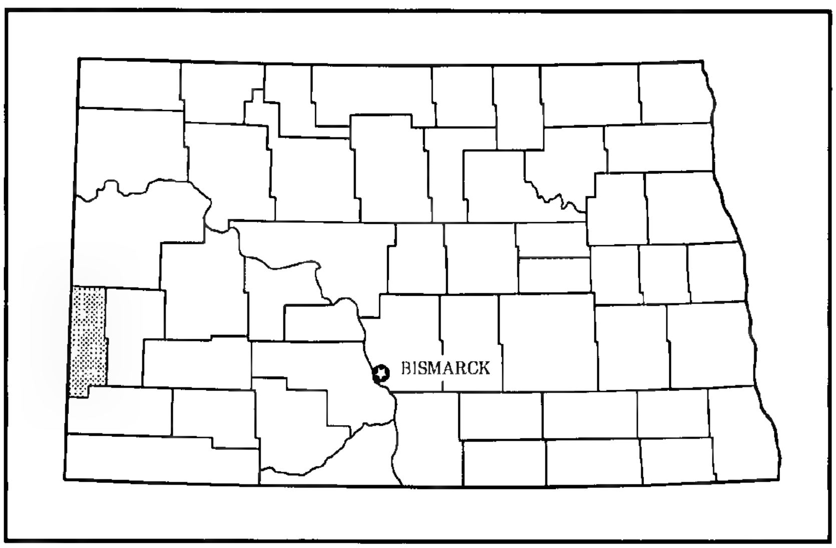


Figure 1.—Location of Golden Valley County in North Dakota.

The county is part of the Badlands Vegetative Zone. It is in the Rolling Soft Shale Plain Land Resource Area of the Northern Great Plains Spring Wheat Region and the Northeastern Part of the Northern Rolling High Plains Land Resource Area of the Western Great Plains Range and Irrigated Region (*4*). It is within the Missouri River Basin. It is bounded on the north by McKenzie County, on the west by Montana, on the south by Slope County, and on the east by Billings and Slope Counties. Golden Valley County includes about 96,000 acres of the National Grasslands, administered by the U.S. Department of Agriculture, Forest Service.

The Little Missouri River enters and leaves the county at two points on the southern border. It flows close to the eastern border. Other important streams include Beaver and Elk Creeks, in the northern part of the county; Wanagan and Knutson Creeks, in the central part; Garner and Bullion Creeks, in the east-central part; and Williams Creek and Bull Run, in the southern part.

Unlike the parts of the state to the north and east, the county was not glaciated. The surface features are the result of erosion on an otherwise unaltered plain. Most of the county is covered by deposits from the Tertiary Period. These deposits consist mainly of silt, sand, clay, and lignite formed in river, lake, and swamp sediment (*8*). Slope is level to moderately steep on the upland plains and ranges to very steep in the Badlands.

The Badlands are in the northeastern and southeastern parts of the county, adjacent to the Little Missouri River. The name "Badlands" is derived from the French term "mauvaise terre," which translates literally as "a land bad for the traveler." Wind and water erosion of the soft clays, silts, and sands have produced the pinnacles, domes, canyons, gorges, ravines, and gullies that characterize the area, which occurs as a syncline in the Missouri Plateau. Local relief ranges from 200 to 400 feet. The burning of exposed lignite beds has produced the reddish color of the clinker-capped hills in this region. This baked reddish material, or porcelainite, is popularly known as scoria and is used to surface roads.

Sentinel Butte is the highest point in the county and one of the highest points in the state, having an elevation of 3,430 feet above sea level. Along with Bullion and Square Buttes, it is part of the White River Formation. The lowest elevation in the county is about 2,100 feet above sea level. It is in an area where Beaver Creek leaves the county, in the northeast corner.

Golden Valley County was included in a soil survey of western North Dakota published in 1908 (*11*). A special report was published in 1979 and a supplement to that report in 1980 (*13*). The special report included most of the central part of the county. The present survey updates all of the earlier surveys. It provides additional information and larger maps, which show the soils in more detail.

General Nature of the County

This section provides general information about the county. It describes climate, settlement and history, natural resources, farming and ranching, and parent material.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Summer in Golden Valley County is usually warm and is marked by frequent hot days. In winter very cold periods occur when arctic air moves in from the north or northeast. The cold periods alternate with milder periods, which often occur when westerly winds are warmed as they move downslope. Precipitation generally falls as rain during the warmer part of the year and is normally heaviest in late spring and early summer. Winter snowfalls are frequent, but the snow cover usually disappears during mild periods. In some years, however, snow remains on the ground for many weeks after a heavy blizzard.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Trotters, North Dakota, in the period 1960 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 15 degrees F, and the average daily minimum temperature is 5 degrees. The lowest temperature on record, which occurred at Trotters on February 28, 1962, is -37 degrees. In summer the average temperature is 67 degrees, and the average daily maximum temperature is 81 degrees. The highest recorded temperature, which occurred on July 6, 1981, is 110 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 15 inches. Of this, nearly 12 inches, or about 80 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 10 inches. The heaviest 1-day rainfall during the period of record was 2.48 inches on May 25, 1965. Thunderstorms occur on about 34 days each year. During some years hailstorms cause severe crop damage in scattered areas.

The average seasonal snowfall is about 31 inches. The greatest snow depth at any one time during the

period of record was 20 inches. On the average, 87 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 12 miles per hour, in spring.

Settlement and History

The settlement of Golden Valley County dates back to the 1800's. The area was Indian domain. Sioux tribes from the north, Crow from the east, and Gros Ventres from the south used the area as hunting grounds. Occasional parties of white hunters or trappers came into the county, but no real settlement took place until the early 1880's (*9*).

In 1873, the U.S. Government sponsored the efforts of surveyors from the North Pacific Railroad. This project was known as the Stanley Railway Survey Expedition. The subsequent report contained the first complete and knowledgeable information about the region's vegetation, resources, and physical features. Among the members of the military escort accompanying the surveyors was Captain Warren C. Beach, for whom the city of Beach is named (*9*).

Homesteading brought settlement ventures to Golden Valley County. The German Catholic Golden Valley Land Company encouraged many Germans from Minnesota, especially Stearns County, to take up land. Polish settlers came from Stearns County, Minnesota, and Greenbush, Minnesota. They settled near Beach and Golva (*12*). A number of Norwegians settled in the central part of the county. Irish, English, Scots, Welsh, French, German-Russians, Swedes, Dutch, Danes, and Canadians also settled in the county (*12*).

Before 1912, Golden Valley County was part of the original Billings County, the boundaries of which included what are today Billings, Bowman, Golden Valley, and Slope Counties.

The population of the county was 4,833 in 1920 and 4,122 in 1930. It has decreased since then. In 1980, it was 2,391. Beach, the largest town, has a population of 1,392. Golva has a population of 101, and Sentinel Butte has one of 86.

Natural Resources

Soil is the most important natural resource in the county. Livestock that graze the grasslands and crops produced on farms are marketable products that are affected by the soil. Water, oil, natural gas, and lignite coal also are important resources.

Golden Valley County has adequate water for domestic uses and for use by livestock. The most dependable source of water is the Fox Hills Sands, which extend throughout the county. The depth to these sands ranges from 750 feet in the southwest corner of the county to 1,900 feet in the northeast corner. Many wells have been drilled into the Fox Hills Formation (*9*).

In various places potable water is available in horizons other than those of the Fox Hills Formation. Ground aquifers with limited contributing areas are throughout the county. Wells drilled to these aquifers extend to a depth of 40 feet. Water contained in deeper sand veins between shallow supplies and the underlying Fox Hills Sands is generally available in the western plateau area of the county. Sources from this level are generally characterized by a high content of minerals, particularly sulfates and iron (*9*).

During periods of high flow, water from the Little Missouri River and Beaver Creek is used to irrigate small areas of cropland. During periods of low flow, however, the water quality is poor. Therefore, the potential for irrigating with surface water is limited. The rest of the streams in the county are characterized by maximum flow rates during the spring and a zero flow rate during many months of the year. Water from alluvial aquifers has a limited potential even for small-scale irrigation because of the limited extent of the aquifers. Generally, unsuitable quality restricts the use of water from the bedrock aquifers for irrigation (*3*). Care is required to ensure that both the soils and the water are suitable for sustained irrigation.

The county sits atop the Fort Union Formation, the major coal-bearing geologic formation in the western United States. About 23,000 acres is underlain by strippable coal reserves. Coal production has been very limited in Golden Valley County. Prior to 1970, a total of about 11 acres had been strip-mined and about 15 acres had been mined from underground. No notable production has occurred since then (*9*).

Sand, gravel, and porcelainite, or scoria, have been mined in the county. They are used mainly for surfacing secondary roads and as a base for paved highways. Uranium, salt, clay, and sandstone are among the other minerals in Golden Valley County. Little use has been made of the hard sandstone. The county has a substantial amount of bentonite clay, but no commercial use has been made of this material (*9*).

Farming and Ranching

The first settlers in Golden Valley County were mainly cattle ranchers. Prior to settlement, the grasslands were grazed by large herds of livestock owned by both companies and individuals. Settlement began after the advent of the railroad in the early 1880's. The settlers began large-scale ranching enterprises. Falling cattle prices and the extremely harsh winter of 1886-87 resulted in the demise of most of the large ranches.

During the 1890's and early 1900's, homesteaders replaced the large operators. By 1910, most of the county's productive land was claimed. An exodus of homesteaders occurred after another severe winter, that of 1919-20. The depression and droughts of the 1930's caused an additional exodus, after which the ranches were confined to the Badlands and the large wheat farms to the more fertile western and central parts of the county (*9*).

Currently, most of the farms are diversified and derive income from cow-calf beef or dairy enterprises and from the sale of sheep or hogs or of small grain crops. A few farms are used mainly for small grain, and several ranchers mainly raise cattle. The cattle ranchers grow oats and barley for feed and grasses and legumes for forage.

The number of farms in the county increased until the 1920's. It decreased from 777 in 1920 to 571 by 1930; 468 by 1954; 308 by 1964; and 288 by 1982. The average size of the farms and ranches was 774 acres in 1930; 1,133 acres in 1950; and 1,776 acres in 1974.

About 253,000 acres, or 39 percent of the land area in the county, is used as cropland. The rest generally supports native grass and is used for range or hay. The major crop is hard red spring wheat, which yields an average of 24 bushels per acre. Other cash crops grown are durum wheat, winter wheat, barley, oats, sunflowers, safflower, flax, and certified seed potatoes. Crops that are grown as feed for livestock are oats, corn cut for silage, alfalfa, tame grasses, and sweetclover (*7*).

The Golden Valley Soil Conservation District was organized in 1948. It includes all of Golden Valley County. In 1956, it was enlarged to include the portion of Billings County west of the Little Missouri River. The Soil Conservation Service furnishes technical assistance to the district.

Parent Material

The parent material of the soils in Golden Valley County has several different origins. The most extensive parent material is weathered from soft bedrock of the Tertiary Period. The two formations of this period are the White River Formation (Oligocene Period) and the Fort Union Formation (Paleocene Period).

White River, the upper member of the two formations, is the youngest residual deposit in the county and in the state. In Golden Valley County, Sentinel, Square, and Bullion Buttes have caps of this formation. The Sentinel Butte member of the Fort Union Formation crops out around these buttes and around smaller buttes. This formation consists of limestone and sandstone. Cabbart and Flasher soils formed in material weathered from the Fort Union Formation. Outwash has accumulated on the sides and at the base of some buttes. Baahish soils formed in this outwash.

Fort Union is the oldest geologic formation exposed in the county. It is made up of the Sentinel Butte member, the Tongue River member, and the Ludlow member. The Tongue River member is the most extensive. The three members consist of silt, sand, clay, lignite, petrified wood, and scoria (porcelainite) occurring as soft siltstone, shale, and sandstone. Cabba, Cabbart, and Chama soils formed in material weathered from soft siltstone. Vebar, Flasher, and Beisigl soils formed in material weathered from sandstone.

The parent material of the soils on flood plains and terraces is alluvium deposited by streams. These soils are stratified and in places are subject to flooding. Some have a buried surface layer. Hanly and Glendive soils, along the Little Missouri River, and Havre and Korchea soils, along Beaver Creek, are examples of soils that formed in alluvium.

In some areas the soils formed in material weathered from porcelainite (scoria). Porcelainite was formed by burning lignite coal veins in the Fort Union Formation. The reddish porcelainite, a natural brick, formed when the heat from the burning lignite coal baked the adjacent sediments. Brandenburg soils formed in material weathered from porcelainite.

Shambo, Lawther, Grail, and Grassna soils formed in local alluvium on uplands. Salts, particularly sodium, in the parent material contributed to the formation of the alkali Absher and Belfield soils. Most of these alkali soils are on or near the Ludlow member. Grassna Variant soils and the saline Grail and Grassna soils formed in alluvium that received seepage high in content of salts. Cherry soils formed mainly in alluvial sediment eroded from the Badlands.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By

observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

Dominantly Level, Saline, Silty Soils on Uplands

These soils formed in alluvium. They make up about 2 percent of the county. They are used primarily for cultivated crops; however, scattered areas are used for range, pasture, or hay. The main concerns in managing the soils for cultivated crops are maintaining the content of organic matter and fertility and controlling salinity. The soils are in basins and swales that tend to accumulate salt-laden seepage from higher lying areas. The principal concerns in managing the soils for range are maintaining the vigor of the key native plants and achieving a uniform distribution of grazing.

1. Grail-Grassna-Grassna Variant Association

Deep, well drained and somewhat poorly drained, moderately fine textured and medium textured, level, saline soils

This association consists of soils in basins and swales on uplands. Most areas are drained by shallow drainageways. Slope is 0 to 1 percent.

This association makes up about 2 percent of the county. It is about 35 percent Grail soils, 35 percent Grassna soils, 15 percent Grassna Variant soils, and 15 percent soils of minor extent.

The well drained Grail soils are in swales. Typically, they have a grayish brown surface layer about 8 inches thick. The upper part of this layer is silty clay loam, and the lower part is silt loam. The subsoil is about 33 inches thick. It is dark grayish brown silty clay loam in the upper part, grayish brown silty clay in the next part, and light brownish gray silty clay in the lower part. The substratum to a depth of about 60 inches is light brownish gray. It is clay loam in the upper part and sandy clay loam in the lower part.

The well drained Grassna soils are in swales. Typically, they have a grayish brown silt loam surface soil about 9 inches thick. The subsoil is silty clay loam about 13 inches thick. It is grayish brown in the upper part, brown in the next part, and grayish brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is grayish brown in the upper part, light brownish gray in the next part, and pale yellow in the lower part.

The strongly saline, somewhat poorly drained Grassna Variant soils are in basins. Typically, the surface soil is grayish brown silt loam about 16 inches thick. It contains salts and is mottled in the lower part. The subsoil is about 32 inches thick. It is mottled throughout. It is light brownish gray silt loam in the upper part, pale yellow silt loam in the next part, and light gray loam in the lower part. The substratum to a depth of about 60 inches is pale yellow, mottled silt loam.

Chama, Dimmick, and Golva are the minor soils in this association. These soils are nonsaline. Chama soils are on side slopes. They are well drained and moderately deep. Dimmick soils are in basins and depressions. They are very poorly drained and deep. Golva soils are on toe slopes. They are well drained and deep.

Most areas are cultivated, but some are used as range, hayland, or pasture. The main concerns in managing the soils for cultivated crops are controlling salinity and maintaining fertility and tilth. The soils are suited to small grain and to grasses and legumes for pasture and hay. They are best suited to salt-tolerant crops, such as barley. The main concern in managing the soils for range is maintaining the vigor of the key salt-tolerant native plants.

Dominantly Gently Sloping to Very Steep, Silty and Loamy Soils on Uplands

These soils formed in material weathered from siltstone and porcelainite and in alluvium. They make up about 50 percent of the county. They are used primarily

for range; however, scattered areas are used for cultivated crops. The principal concerns in managing the soils for range are maintaining the vigor of the key native plants and achieving a uniform distribution of grazing. The main concerns in managing the soils for cultivated crops are controlling water erosion and conserving moisture.

2. Badland-Cabbart-Cherry Association

Badland and shallow and deep, well drained, medium textured, gently sloping to very steep soils

This association consists of soils on ridges, knobs, side slopes, and foot slopes in the uplands. Most areas are drained by entrenched streams and drainageways. Slope ranges from 3 to 50 percent.

This association makes up about 28 percent of the county. It is about 30 percent Badland, 30 percent Cabbart soils, 20 percent Cherry soils, and 20 percent soils of minor extent.

The Badland consists of exposed, eroding, soft, silty and clayey bedrock. It typically is on south-facing slopes. It is barren of vegetation.

The shallow, moderately sloping to very steep Cabbart soils are on ridges and knobs. Typically, they have a light brownish gray silt loam or loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock.

The deep, gently sloping to strongly sloping Cherry soils are on side slopes and foot slopes. Typically, they have a brown silt loam surface layer about 4 inches thick. The subsoil is about 22 inches thick. It is pale brown silt loam in the upper part and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale yellow silt loam.

Absher, Brandenburg, Flasher, and Havre are the minor soils in this association. Absher soils are on toe slopes and foot slopes. They are moderately well drained, are deep, and have an alkali subsoil. Brandenburg soils are on ridges and hills. They are excessively drained and have a substratum of fractured porcelainite. Flasher soils are on ridges. They are somewhat excessively drained, are shallow, and have a loamy sand surface layer and substratum. Havre soils are on flood plains. They are deep and well drained.

Most areas are used for range or wildlife habitat. The main concerns in managing the soils for range are achieving a uniform distribution of grazing, maintaining the vigor of the key native plants, and developing dependable watering facilities for livestock. The soils generally are unsuited to small grain and to grasses and legumes for pasture and hay.

3. Brandenburg-Cabbart Association

Deep and shallow, excessively drained and well drained, medium textured, moderately sloping to very steep soils

This association consists of soils on ridges, knobs, hills, shoulder slopes, and side slopes in the uplands. Most areas are drained by intermittent drainageways. Slope ranges from 6 to 50 percent.

This association makes up about 7 percent of the county. It is about 50 percent Brandenburg soils, 30 percent Cabbart soils, and 20 percent soils of minor extent.

The deep, excessively drained Brandenburg soils are on ridges, knobs, and hills. Typically, they have a light brown channery loam surface layer about 6 inches thick. The substratum extends to a depth of 60 inches or more. It is light red and pink very channery loam in the upper part and light red, fractured porcelainite in the lower part.

The shallow, well drained Cabbart soils are on shoulder slopes, side slopes, and ridges. Typically, they have a light brownish gray loam or silt loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock.

Absher, Belfield, Chama, Cherry, Lawther, Moreau, and Shambo are the minor soils in this association. Also of minor extent are areas of rock outcrop. Absher and Belfield soils are on flats. They have an alkali subsoil. Chama and Moreau soils are on side slopes. They are moderately deep. Cherry, Lawther, and Shambo soils are deep and well drained. Cherry soils are on side slopes and foot slopes, and Lawther and Shambo soils are on flats.

Most areas are used for range or wildlife habitat. The main concerns in managing the soils for range are achieving a uniform distribution of grazing, maintaining the vigor of the key native plants, and developing dependable watering facilities for livestock. The soils generally are unsuited to small grain and to grasses and legumes for pasture and hay.

4. Cabbart-Cherry Association

Shallow and deep, well drained, medium textured, gently sloping to very steep soils

This association consists of soils on ridges, knobs, buttes, side slopes, and foot slopes in the uplands. Most areas are drained by entrenched drainageways. Slope ranges from 3 to 50 percent.

This association makes up about 15 percent of the county. It is about 50 percent Cabba soils, 30 percent Cherry soils, and 20 percent soils of minor extent.

The shallow, moderately sloping to very steep Cabbart soils are on ridges, knobs, buttes, and the upper side slopes. Typically, they have a light brownish gray silt loam or loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock.

The deep, gently sloping to strongly sloping Cherry soils are on side slopes and foot slopes. Typically, they have a brown silt loam surface layer about 4 inches

thick. The subsoil is about 22 inches thick. It is pale brown silt loam in the upper part and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale yellow silt loam.

Amor, Beisigl, Chama, Flasher, and Havre soils and Badland are of minor extent in this association. Amor, Beisigl, and Chama soils are on side slopes. They are moderately deep. Flasher soils are on ridges. They are shallow and somewhat excessively drained. Havre soils are on flood plains. They are deep and well drained. Badland consists of exposed, eroding, soft, silty and clayey bedrock.

Most areas are used for range or wildlife habitat; however, some areas of the nearly level soils are cultivated. The main concerns in managing the soils for range are achieving a uniform distribution of grazing, maintaining the vigor of the key native plants, and developing watering facilities for livestock. The soils generally are unsuited to small grain and to grasses and legumes for pasture and hay, but the gently sloping and moderately sloping Cherry soils are suitable. The main concern in managing the Cherry soils for cultivated crops is controlling water erosion.

Dominantly Nearly Level to Strongly Sloping, Silty Soils on Uplands

These soils formed in material weathered from siltstone and sandstone and in alluvium. They make up about 32 percent of the county. They are used primarily for cultivated crops; however, scattered areas are used for range. The main concern in managing the soils for cultivated crops is controlling water erosion and soil blowing. The principal concerns in managing the soils for range are controlling water erosion and soil blowing, maintaining the vigor of the key native plants, and achieving a uniform distribution of grazing.

5. Cabba-Chama Association

Shallow and moderately deep, well drained, medium textured, nearly level to strongly sloping soils

This association consists of soils on ridges, knobs, summits, and side slopes in the uplands. Most areas are drained by entrenched drainageways. Slope ranges from 1 to 15 percent.

This association makes up about 2 percent of the county. It is about 50 percent Cabba soils, 30 percent Chama soils, and 20 percent soils of minor extent.

The shallow, gently sloping to strongly sloping Cabba soils are on narrow ridges and knobs. Typically, they have a light brownish gray silt loam surface layer about 6 inches thick. The substratum is light gray silt loam about 9 inches thick. Below this is soft siltstone bedrock.

The moderately deep, nearly level to strongly sloping Chama soils are on side slopes and the summit of ridges. Typically, they have a grayish brown silt loam surface layer about 4 inches thick. The subsoil is silt loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is light gray silt loam about 10 inches thick. Below this is soft siltstone bedrock.

Amor, Beisigl, Brandenburg, Cherry, Golva, and Havre are the minor soils in this association. Amor and Beisigl soils are on side slopes. They are moderately deep. Brandenburg soils are on the top of hills and on ridges. They have a substratum of fractured porcelainite (scoria). Cherry and Golva soils are deep. Cherry soils are on side slopes and foot slopes, and Golva soils are on foot slopes. Havre soils are on flood plains. They are deep and well drained.

Most areas are used for range, but some are used for cultivated crops, hay, or pasture. The main concerns in managing the soils for range are controlling water erosion and soil blowing, maintaining the vigor of the key native plants, and achieving a uniform distribution of grazing. The soils are poorly suited to small grain and to grasses and legumes for pasture and hay.

6. Chama-Golva-Cabba Association

Moderately deep, deep, and shallow, well drained, medium textured, nearly level to strongly sloping soils

This association consists of soils on ridges, knobs, side slopes, and foot slopes in the uplands. Most areas are drained by intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 30 percent of the county. It is about 35 percent Chama soils, 30 percent Golva soils, 15 percent Cabba soils, and 20 percent soils of minor extent (fig. 2).

The moderately deep, nearly level to strongly sloping Chama soils are on side slopes and the summit of ridges. Typically, they have a grayish brown silt loam surface layer about 4 inches thick. The subsoil is silt loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is light gray silt loam about 10 inches thick. Below this is soft siltstone bedrock.

The deep, nearly level and gently sloping Golva soils are on foot slopes. Typically, they have a grayish brown silt loam surface layer about 6 inches thick. The subsoil is about 26 inches thick. It is grayish brown silty clay loam in the upper part, pale brown silt loam in the next part, and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is light gray silty clay loam.

The shallow, gently sloping to strongly sloping Cabba soils are on ridges and knobs. Typically, they have a light brownish gray silt loam surface layer about 6 inches thick. The substratum is light gray silt loam about 9 inches thick. Below this is soft siltstone bedrock.

Amor, Dimmick, Grassna, Grassna Variant, Sen, and Wanagan are the minor soils in this association. Amor soils are on side slopes. They have a loam surface layer

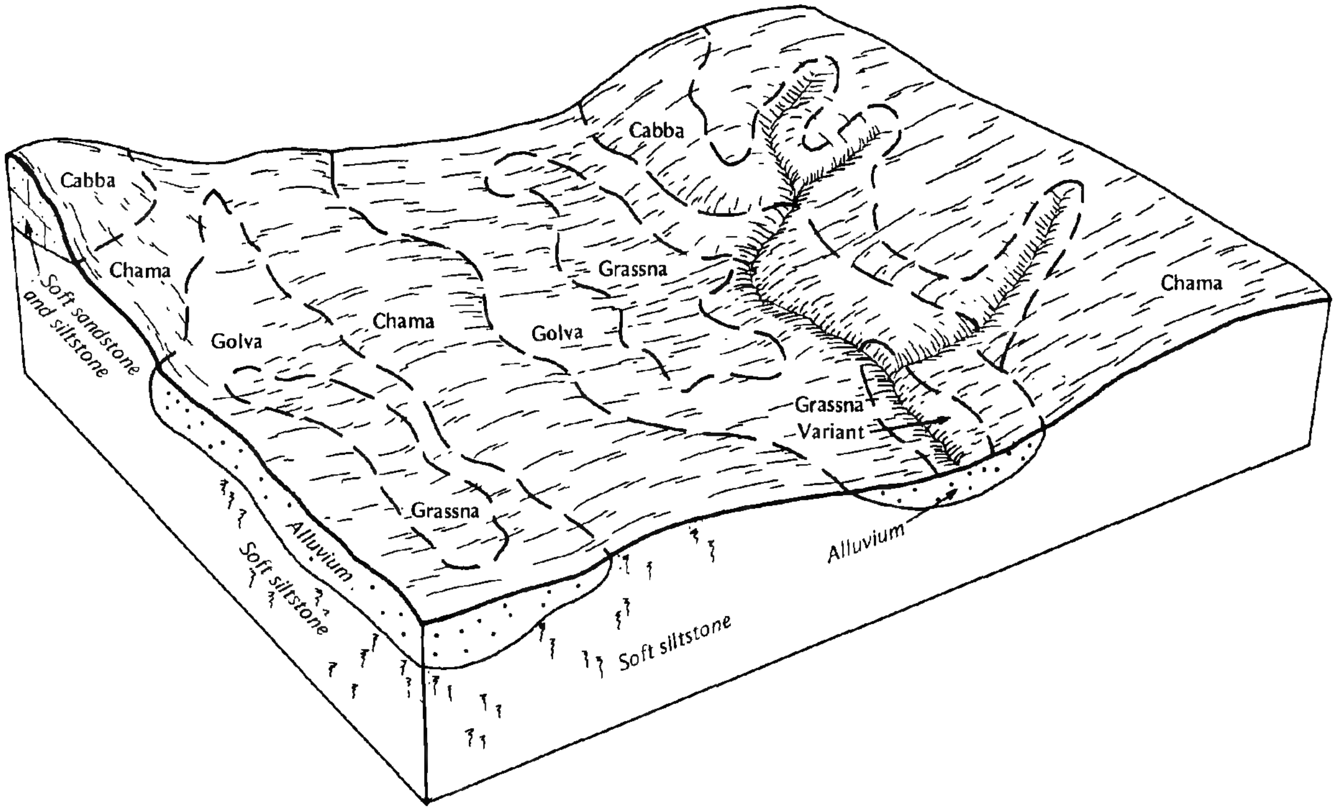


Figure 2.—Typical pattern of soils and parent material in the Chama-Golva-Cabba association.

and subsoil. Dimmick soils are in depressions and shallow basins. They are very poorly drained. Grassna soils are in swales. They are deep and have a dark surface soil more than 16 inches thick. Grassna Variant soils are adjacent to drainageways. They are somewhat poorly drained. Sen soils are on side slopes. They have lime below a depth of 10 inches. Wanagan soils are on terraces. They have a gravelly substratum.

Most areas are used for cultivated crops. The main concerns in managing the soils for cultivated crops are controlling water erosion and soil blowing and conserving moisture. The soils are suited to small grain and to grasses and legumes for pasture and hay.

Dominantly Nearly Level and Gently Sloping, Alkali, Loamy Soils on Uplands

These soils formed in material weathered from siltstone and shale and in alluvium. They make up about 4 percent of the county. They are used primarily for range; however, scattered areas are used for cultivated crops. The main concerns in managing the soils for range are maintaining the vigor of the key native plants, achieving a uniform distribution of grazing, and developing facilities that can provide nonsalty water to livestock. The principal concerns in managing the soils for cultivated crops are conserving moisture and controlling water erosion.

7. Absher-Belfield Association

Deep, moderately well drained and well drained, medium textured, nearly level and gently sloping, alkali soils

This association consists of soils on broad flats in the uplands. Most areas are drained by streams and entrenched drainageways. Slope ranges from 1 to 6 percent.

This association makes up about 4 percent of the county. It is about 50 percent Absher soils, 30 percent Belfield soils, and 20 percent soils of minor extent (fig. 3).

The moderately well drained Absher soils are in microdepressions on flats. Typically, they have a light brownish gray loam surface layer about 2 inches thick. The subsoil is about 56 inches thick. In sequence downward, it is grayish brown silty clay, grayish brown clay loam, light brownish gray clay loam, and light brownish gray silty clay loam. The substratum to a depth of about 60 inches is light brownish gray clay loam.

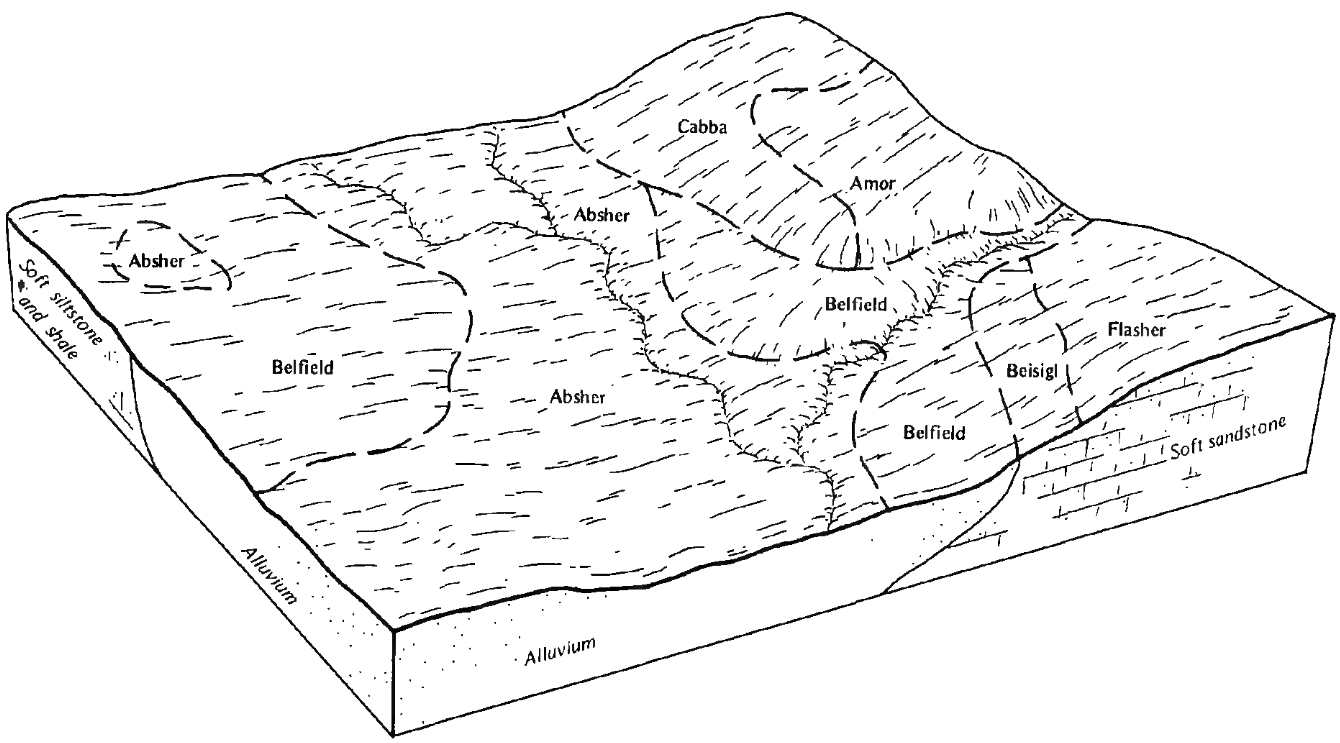


Figure 3.—Typical pattern of soils and parent material in the Absher-Belfield association.

The well drained Belfield soils are on microhighs on flats. Typically, the surface soil is loam about 11 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The next layer is brown clay loam about 10 inches thick. It has grayish brown silt coatings in the upper part. The subsoil is about 29 inches thick. It is very pale brown clay loam in the upper part, light gray clay loam in the next part, and light gray loam in the lower part. The substratum to a depth of about 60 inches is light gray fine sandy loam.

Amor, Beisigl, Cabba, Flasher, Moreau, Parshall, and Wayden are the minor soils in this association. Amor, Beisigl, and Moreau soils are on side slopes. They are moderately deep. Cabba, Flasher, and Wayden soils are on knobs and ridges. They are shallow. Parshall soils are in swales. They have a fine sandy loam surface soil and subsoil.

Most areas are used for range, but some are used for cultivated crops. The main concerns in managing the soils for range are controlling water erosion, conserving moisture, and achieving a uniform distribution of grazing. The Belfield soils are suited to small grain and to grasses and legumes for pasture and hay, but the Absher soils generally are unsuited.

Dominantly Nearly Level to Very Steep, Sandy and Loamy Soils on Uplands

These soils formed in material weathered from sandstone. They make up about 8 percent of the county. About half of the acreage is used for range and half for cultivated crops. The main concerns in managing the soils for range are controlling soil blowing, achieving a uniform distribution of grazing, and maintaining the vigor of the key native plants. The principal concerns in managing the soils for cultivated crops are controlling soil blowing and overcoming droughtiness.

8. Flasher-Vebar-Beisigl Association

Shallow and moderately deep, somewhat excessively drained and well drained, coarse textured and moderately coarse textured, nearly level to very steep soils

This association consists of soils on ridges, hills, knobs, and side slopes in the uplands. Most areas are drained by small streams and entrenched drainageways. Slope ranges from 1 to 45 percent.

This association makes up about 8 percent of the county. It is about 40 percent Flasher soils, 30 percent Vebar soils, 20 percent Beisigl soils, and 10 percent soils of minor extent (fig. 4).

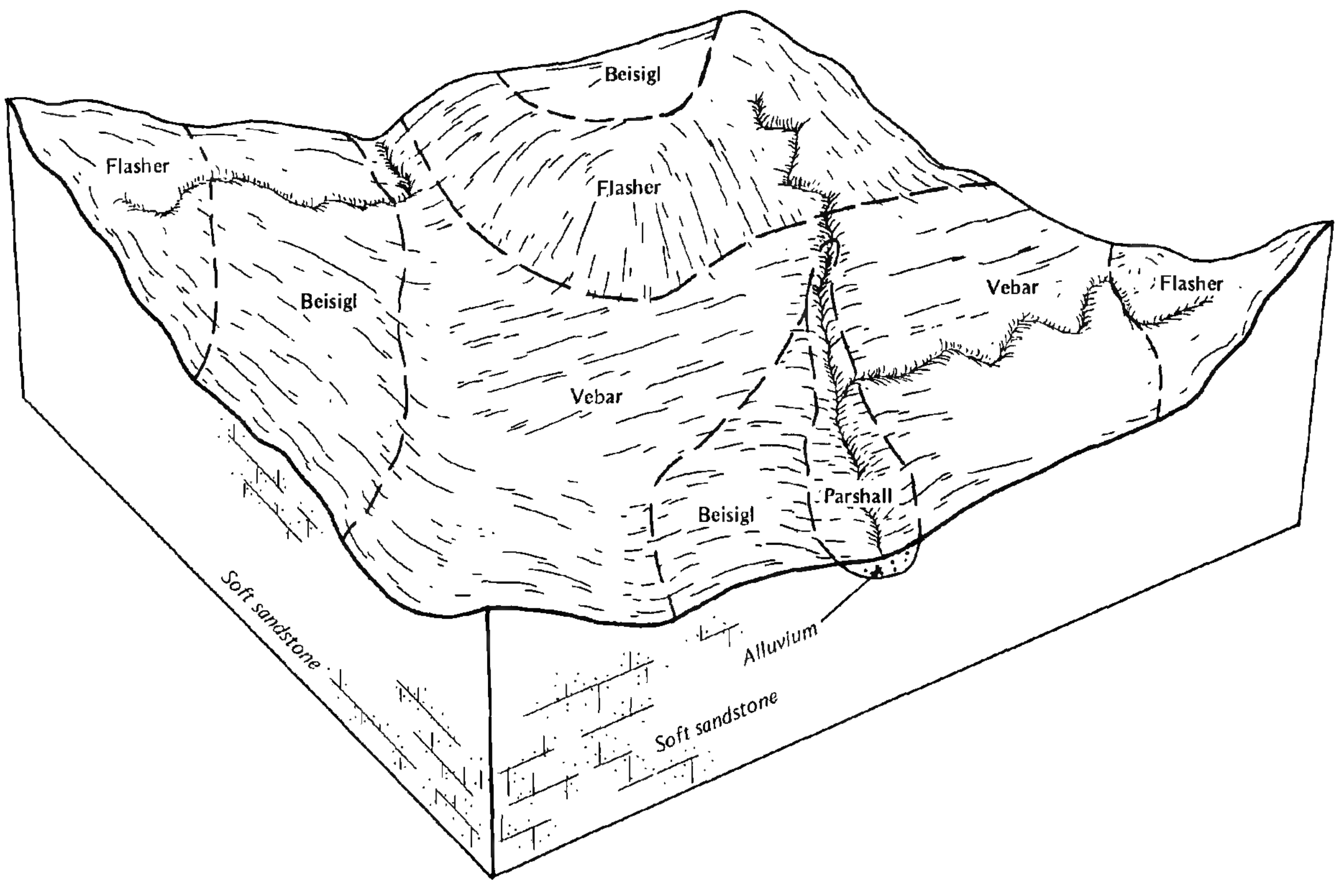


Figure 4.—Typical pattern of soils and parent material in the Flasher-Vebar-Beisigl association.

The shallow, moderately sloping to very steep, somewhat excessively drained Flasher soils are on ridges, knobs, and hills. Typically, they have a light brownish gray loamy sand surface layer about 6 inches thick. The substratum is light gray loamy sand about 5 inches thick. Below this is soft sandstone bedrock.

The moderately deep, nearly level to moderately sloping, well drained Vebar soils are on side slopes. Typically, they have a grayish brown fine sandy loam surface soil about 11 inches thick. The subsoil is about 15 inches thick. It is brown fine sandy loam in the upper part, pale brown sandy loam in the next part, and light gray fine sandy loam in the lower part. The substratum is light gray fine sandy loam about 12 inches thick. Below this is soft sandstone bedrock.

The moderately deep, gently sloping to strongly sloping, somewhat excessively drained Beisigl soils are on side slopes. Typically, the surface layer is loamy sand about 9 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The subsoil is loamy sand about 25 inches thick. It is light brownish gray in the upper part and light gray in the lower part. Below this is soft sandstone bedrock.

Absher, Amor, Belfield, Chama, Moreau, and Parshall are the minor soils in this association. Absher and Belfield soils are on flats. They have an alkali subsoil. Amor, Chama, and Moreau soils are on side slopes. Amor soils have a loam surface layer and subsoil. Chama soils have a silt loam surface layer and subsoil. Moreau soils have a silty clay subsoil. Parshall soils are in swales. They are deep.

About half of this association is used for cultivated crops and half for range. The nearly level to moderately sloping soils generally are used for cultivated crops, and the strongly sloping to very steep soils are used for range. The main concerns in managing the soils for cultivated crops are controlling soil blowing and conserving moisture. The soils are poorly suited to small grain and to grasses and legumes for pasture and hay. The main concerns in managing the soils for range are developing watering facilities for livestock, controlling soil blowing, and achieving a uniform distribution of grazing.

Dominantly Level to Moderately Steep, Loamy and Silty Soils on Flood Plains, Terraces, and Outwash Plains

These soils formed in alluvium and outwash sediments. They make up about 4 percent of the county. They are used primarily for range and cultivated crops. The main concerns in managing the soils for cultivated crops are maintaining fertility and conserving moisture. The principal concerns in managing the soils for range are achieving a uniform distribution of grazing and maintaining the vigor of the key native plants.

9. Wanagan-Shambo-Baahish Association

Deep, well drained and somewhat excessively drained, medium textured, nearly level to moderately steep soils

This association consists of soils on terraces and outwash plains. Most areas are drained by entrenched streams. Slope ranges from 1 to 25 percent.

This association makes up about 1 percent of the county. It is about 30 percent Wanagan soils, 30 percent Shambo soils, 20 percent Baahish soils, and 20 percent soils of minor extent.

The nearly level and gently sloping, well drained Wanagan soils are on flats. Typically, they have a dark grayish brown loam surface layer about 7 inches thick. The subsoil is loam about 12 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is very pale brown and brown very gravelly sandy clay loam. The upper part of the substratum is pale brown very gravelly fine sandy loam. The lower part to a depth of about 60 inches is light brownish gray extremely gravelly loam.

The nearly level and gently sloping, well drained Shambo soils are on flats. Typically, they have a grayish brown loam surface layer about 5 inches thick. The subsoil is about 31 inches thick. It is brown loam in the upper part, brown silt loam in the next part, and light gray loam in the lower part. The upper part of the substratum is light gray loam. The lower part to a depth of about 60 inches is light brown gravelly loam.

The moderately sloping to moderately steep, somewhat excessively drained Baahish soils are on ridges and knobs. Typically, they have a dark brown loam surface layer about 5 inches thick. The subsoil is brown gravelly loam about 3 inches thick. The substratum to a depth of about 60 inches is very gravelly loam. It is pale brown in the upper part, light yellowish brown in the next part, and pale brown in the lower part.

Amor, Cabba, Cabbart, Chama, Golva, and Havre are the minor soils in this association. Amor and Chama soils are on side slopes. They are moderately deep. Cabba and Cabbart soils are on knobs and ridges. They are shallow. Golva soils are on foot slopes. They are silt loam throughout. Havre soils are on flood plains. They are silt loam and loam throughout.

Most of this association is used for cultivated crops. Some areas of the strongly sloping to moderately steep soils are used for range. The Baahish and Wanagan soils are a source of gravel. The main concerns in managing the soils for cultivated crops are maintaining tilth and the content of organic matter and conserving moisture. The soils generally are suited to small grain and to grasses and legumes for pasture and hay, but the Baahish soils generally are unsuited.

10. Havre-Korchea Association

Deep, well drained, medium textured, level and nearly level soils

This association consists of soils on flood plains and terraces (fig. 5). Most areas are drained by the major streams. Slope ranges from 0 to 3 percent.

This association makes up about 2 percent of the county. It is about 50 percent Havre soils, 30 percent Korchea soils, and 20 percent soils of minor extent.

Havre soils are on flood plains that are generally dissected by meandering channels and steep escarpments. Typically, they have a light brownish gray silt loam surface layer about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray. In sequence downward, it is silt loam, loam, stratified silt loam and silty clay loam, and loam.

Korchea soils are on flood plains and terraces. Typically, they have a grayish brown silt loam surface layer about 6 inches thick. The substratum extends to a depth of 60 inches or more. In sequence downward, it is pale brown very fine sandy loam, grayish brown silt loam, light brownish gray silt loam, grayish brown and brown silt loam, and pale brown silt loam.

Cabba, Cabbart, Cherry, Shambo, and Wanagan are the minor soils in this association. Also of minor extent are areas of Badland. Cabba and Cabbart soils are on knobs and ridges. They are shallow. Cherry soils are on side slopes and foot slopes. They have a silt loam surface layer and a silt loam and loam subsoil. Shambo soils are on terraces. They are well drained and are gravelly loam in the lower part of the substratum. Wanagan soils are on terraces. They are extremely gravelly loam in the lower part of the substratum.

Most areas are used for range; however, some areas are used for cultivated crops, hay, or pasture. The main concerns in managing the soils for range are maintaining the vigor of the key native plants and achieving a uniform distribution of grazing. The soils are suited to small grain and to grasses and legumes for hay and pasture. The main concerns in managing the soils for cultivated crops are conserving moisture and maintaining tilth and fertility.

11. Hanly-Glendive Association

Deep, somewhat excessively drained and well drained, moderately coarse textured, level and nearly level soils

Figure 5.—An area of the Havre-Korchea association in a stream valley. The occasionally flooded Havre and rarely flooded Korchea soils are used mainly for range. Badland and Cabbart and Cherry soils are on the adjacent uplands.

This association consists of soils on flood plains and terraces. Most areas are drained by the major streams. Slope ranges from 0 to 3 percent.

This association makes up less than 1 percent of the county. It is about 50 percent Hanly soils, 30 percent Glendive soils, and 20 percent soils of minor extent.

The somewhat excessively drained Hanly soils are on flood plains and terraces. Typically, they have a grayish brown fine sandy loam surface layer about 3 inches thick. The substratum to a depth of about 60 inches is stratified. In sequence downward, it is brown loamy fine sand, light brownish gray very fine sandy loam, light brownish gray fine sand, light brownish gray loamy fine sand, light brownish gray loam, light brownish gray silty clay loam, and light brownish gray fine sand.

The well drained Glendive soils are on flood plains and terraces. Typically, they have a grayish brown fine sandy loam surface layer about 5 inches thick. The substratum to a depth of about 60 inches is stratified. In sequence downward, it is grayish brown and light brownish gray loam, grayish brown and light brownish gray silt loam, and light brownish gray and light gray fine sandy loam.

Cabbart, Cherry, Havre, and Korchea are the minor soils in this association. Also of minor extent are areas of Badland. Cabbart soils are on ridges and knobs. They are shallow. Cherry and Havre soils have a silt loam surface layer. Cherry soils are on side slopes and foot slopes, and Havre soils are on flood plains. Korchea soils are on flood plains and terraces. They have a surface layer that is darker than that of the Hanly and Glendive soils.

Most areas are used for range; however, some areas are used for cultivated crops, hay, or pasture. The main concerns in managing the soils for range are controlling soil blowing, maintaining the vigor of the key native plants, and achieving a uniform distribution of grazing. The soils are poorly suited to small grain and to grasses and legumes for pasture and hay. The main concerns in managing the soils for cultivated crops are controlling soil blowing and conserving moisture.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Golva silt loam, 1 to 3 percent slopes, is a phase of the Golva series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Chama-Cabba silt loams, 3 to 9 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Badland is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

3—Havre silt loam, channeled. This deep, level and nearly level, well drained soil is on flood plains. It is occasionally flooded. Most areas are dissected into small, irregularly shaped tracts by meandering channels and steep escarpments. Individual areas range from about 5 to 100 acres in size.

Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray. In sequence downward, it is silt loam, loam, stratified silt loam and silty clay loam, and loam. In some places the surface layer is loam. In other places it is grayish brown or dark grayish brown.

Included with this soil in mapping are small areas of Cherry, Golva, and Korchea soils. These soils make up about 5 to 20 percent of the unit. Cherry and Golva soils are not stratified. They are on upland foot slopes. Korchea soils have a surface layer that is darker than that of the Havre soil. They are in the higher areas on the flood plains. Also included are some areas of Badland.

Permeability is moderate in the Havre soil. Runoff is slow. Available water capacity is high.

Most areas are used for range. This soil generally is unsuited to cultivated crops and to grasses and legumes for hay and pasture. It is best suited to range. No major hazards or limitations affect the use of this soil for range. The key range plants are big bluestem, green needlegrass, and western wheatgrass. Maintaining an adequate cover of the key plants helps to protect the

soil from erosion and helps to control siltation during floods.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. The irregularly shaped areas and meandering channels make the use of machinery difficult.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Soils that are not subject to flooding generally are nearby.

The land capability classification is VIw. The range site is Overflow. The productivity index for spring wheat is 0.

4—Grassna silt loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on toe slopes and in drainageways on uplands. Individual areas range from about 5 to 70 acres in size.

Typically, the surface soil is grayish brown silt loam about 17 inches thick. The subsoil is silt loam about 35 inches thick. It is brown in the upper part and light gray in the lower part. The substratum to a depth of about 60 inches is light brownish gray silty clay loam. In some places the surface layer and subsoil are loam. In other places the soil contains small amounts of gravel or scoria below a depth of 40 inches. In some areas the dark color of the surface soil extends only to a depth of 8 to 16 inches. In other areas the subsoil has an accumulation of clay.

Included with this soil in mapping are small areas of Sen and Vebar soils on side slopes. These soils make up about 5 to 10 percent of the unit. They are moderately deep.

Permeability is moderate in the Grassna soil. Runoff is slow. The soil receives runoff from the adjacent soils. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main concerns in managing cultivated areas are maintaining tilth and fertility and controlling erosion in areas where runoff concentrates. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control local erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, big bluestem, and green needlegrass. Intermediate, pubescent, and western wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIc. The range site is Overflow. The productivity index for spring wheat is 99.

6—Grassna Variant silt loam. This deep, level, somewhat poorly drained, strongly saline soil is in basins, depressions, and drainageways on uplands (fig. 6). Individual areas range from about 5 to 70 acres in size.

Typically, the surface soil is grayish brown silt loam about 16 inches thick. It contains salts and is mottled in the lower part. The subsoil is about 32 inches thick. It is light brownish gray, mottled silt loam in the upper part; pale yellow, mottled silt loam in the next part; and light gray, mottled loam in the lower part. The substratum to a depth of about 60 inches is pale yellow, mottled silt loam. In some places the soil has a layer of lime accumulation at a depth of 8 to 16 inches. In other places the dark color of the surface soil extends only to a depth of 8 to 16 inches.

Included with this soil in mapping are small areas of Chama and Dimmick soils. These soils make up about 5 to 15 percent of the unit. Chama soils are moderately deep. They are on side slopes. Dimmick soils are very poorly drained. They are intermingled with areas of the Grassna Variant soil.

Permeability is moderate in the Grassna Variant soil. Runoff is slow. Available water capacity is moderate. The salts in the soil reduce the amount of water available to plants. A seasonal high water table is within a depth of 2 feet.

Most areas are used for range, pasture, or hay. This soil generally is unsuited to trees, shrubs, and cultivated crops because of the salinity. The key range plants are western wheatgrass, inland saltgrass, and Nuttall alkaligrass. The high content of salts, the reduced amount of available water, compaction, trampling, and root shearing are problems, especially if the range is grazed when the soil is wet. They can be overcome by maintaining adequate amounts of the key salt-tolerant plants and by deferring grazing when the soil is wet.

Figure 6.—An area of Grassna Variant silt loam. Bare areas, a white salt crust, and kochia are common in areas of this strongly saline soil.

Stock water ponds constructed in areas of this soil frequently contain salty water.

This soil generally is unsuited to buildings and septic tank absorption fields because of the salinity and the wetness. Better sites generally are nearby.

The land capability classification is VIs. The range site is Saline Lowland. The productivity index for spring wheat is 0.

9C—Cabba-Chama silt loams, 3 to 9 percent slopes. These gently sloping and moderately sloping, well drained soils are on uplands. The shallow Cabba soil is on ridges and knobs. The moderately deep Chama soil is on side slopes. Individual areas range from about 10 to 150 acres in size. They are about 65 to 75 percent Cabba soil and 15 to 25 percent Chama soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabba soil has a light brownish gray silt loam surface layer about 6 inches thick. The substratum is light gray silt loam about 9 inches thick. Below this is soft siltstone bedrock. In places the depth to bedrock is only 2 to 10 inches.

Typically, the Chama soil has a grayish brown silt loam surface layer about 4 inches thick. The subsoil is silt loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is light gray silt loam about 10 inches thick. Below this is soft siltstone bedrock.

Included with these soils in mapping are small areas of the deep Golva soils on foot slopes. These included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Cabba and Chama soils. Runoff is medium. Available water capacity is very low in the Cabba soil and low in the Chama soil. The bedrock underlying both soils restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. These soils generally are unsuited to cultivated crops because of droughtiness and the erosion hazard. They are best suited to grasses and legumes for hay and pasture or to range. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. If the soils are cultivated, maintaining productivity, overcoming droughtiness, and controlling erosion are the main management concerns. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain or improve fertility and tilth and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on these soils are western wheatgrass, needleandthread, and little bluestem. Intermediate and pubescent wheatgrass, smooth bromegrass, and sweetclover are suitable hay and pasture plants. Water erosion and soil blowing are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Chama soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabba soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soils tend to be deeper and where the Chama soil is located, are better sites for waste disposal than the upper parts.

The land capability classification of the Cabba soil is VIs, and that of the Chama soil is IIIe. The range site of the Cabba soil is Shallow, and that of the Chama soil is Silty. The productivity index of the unit for spring wheat is 0.

9D—Cabba-Chama silt loams, 9 to 15 percent slopes. These strongly sloping, well drained soils are on uplands. The shallow Cabba soil is on ridges and knobs. The moderately deep Chama soil is on side slopes. Individual areas range from about 10 to 100 acres in size. They are about 60 to 70 percent Cabba soil and 20 to 30 percent Chama soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabba soil has a light brownish gray silt loam surface layer about 6 inches thick. The substratum is light gray silt loam about 9 inches thick. Below this is soft siltstone bedrock. In places the depth to bedrock is only 2 to 10 inches.

Typically, the Chama soil has a grayish brown silt loam surface layer about 4 inches thick. The subsoil is silt loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is light gray silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the surface layer and subsoil are loam.

Included with these soils in mapping are small areas of Baahish and Flasher soils on ridges and knolls. These included soils make up about 5 to 10 percent of the unit. Baahish soils are deep and have a substratum of fractured porcelainite. Flasher soils have a loamy sand surface layer and substratum.

Permeability is moderate in the Cabba and Chama soils. Runoff is medium. Available water capacity is very low in the Cabba soil and low in the Chama soil. The bedrock underlying both soils restricts the depth to which plant roots can penetrate.

Most areas are used for range. Some are used for cultivated crops, hay, or pasture. These soils generally are unsuited to cultivated crops. They are best suited to grasses and legumes for hay and pasture or to range. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. If the soils are cultivated, maintaining productivity, overcoming droughtiness, and controlling erosion are the main management concerns. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain or improve fertility and tilth and increases the rate of water infiltration. Leaving

tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on these soils are western wheatgrass, needleandthread, and little bluestem. Intermediate and pubescent wheatgrass, smooth bromegrass, and sweetclover are suitable hay and pasture plants. Water erosion and soil blowing are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Chama soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabba soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soils tend to be deeper and where the Chama soil is located, are better sites for waste disposal than the upper parts. The buildings and absorption fields should be designed so that they conform to the natural slope of the land.

The land capability classification of the Cabba soil is VIe, and that of the Chama soil is IVe. The range site of the Cabba soil is Shallow, and that of the Chama soil is Silty. The productivity index of the unit for spring wheat is 0.

10F—Cabbart-Badland complex, 15 to 50 percent slopes. This map unit occurs as areas of a moderately steep to very steep, well drained, shallow Cabbart soil intermingled with areas of Badland. The unit is on uplands. The Cabbart soil is on ridges and knobs. The Badland is on side slopes and summits. Slumps and areas of earth slippage are common. Individual areas range from about 10 to 2,000 acres in size. They are about 45 to 55 percent Cabbart soil and 30 to 40 percent Badland. The Cabbart soil and the Badland occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabbart soil has a light brownish gray silt loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock. In some places the surface layer and subsoil are sandy loam. In other places they are silty clay loam. In some areas the soil has a substratum of fractured porcelainite.

Typically, the Badland consists of exposed, soft, silty and clayey, barren sedimentary bedrock that is highly erodible. It typically is on south-facing slopes.

Included with this unit in mapping are small areas of the deep Cherry soils on side slopes and foot slopes and small areas of rock outcrop. The rock outcrop forms a rimrock. Included areas make up about 5 to 10 percent of the unit.

Permeability is moderate in the Cabbart soil. Runoff is rapid. Available water capacity is very low. The bedrock restricts the depth to which plant roots can penetrate.

Most areas are used for range. This unit generally is unsuited to trees, shrubs, and cultivated crops and to grasses and legumes for hay and pasture because of the slope and droughtiness. The key range plants on the Cabbart soil are needleandthread, prairie sandreed, and little bluestem. Water erosion and soil blowing are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. The slope limits the use of machinery. Maintaining an adequate cover of the key plants helps to prevent denuding and excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This unit generally is unsuited to buildings and septic tank absorption fields because of the slope. Better sites generally are nearby.

The land capability classification of the Cabbart soil is VIIe, and that of the Badland is VIIIe. The range site of the Cabbart soil is Shallow. The Badland is not assigned to a range site. The productivity index of the unit for spring wheat is 0.

11F—Brandenburg-Cabbart complex, 6 to 50 percent slopes. These moderately sloping to very steep soils are on uplands. The deep, excessively drained Brandenburg soil is on ridges and hills. The shallow, well drained Cabbart soil is on shoulder slopes and side slopes. Individual areas range from about 10 to 1,000 acres in size. They are about 50 to 60 percent Brandenburg soil and 25 to 35 percent Cabbart soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Brandenburg soil has a light brown channery loam surface layer about 6 inches thick. The upper part of the substratum is light red and pink very channery loam. The lower part to a depth of about 60 inches is light red, fractured porcelainite. In places large clinkers cover the surface. In some places the

porcelainite (scoria) is at the surface. In other places it is at a depth of 20 to 40 inches.

Typically, the Cabbart soil has a light brownish gray silt loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the surface layer and subsoil are silty clay loam or sandy loam.

Included with these soils in mapping are small areas of Absher, Cherry, Lawther, and Shambo soils. These included soils make up about 5 to 15 percent of the unit. Absher soils have an alkali subsoil. They are on foot slopes. Cherry soils are deep and have a silt loam substratum. They are on side slopes. Lawther soils have a silty clay loam surface layer. They are on foot slopes. Shambo soils are deep and are gravelly loam in the lower part of the substratum. They are on foot slopes and in narrow drainageways. Also included are small areas of Badland.

Permeability is moderate in the upper part of the Brandenburg soil and very rapid in the lower part. It is moderate in the Cabbart soil. Runoff is medium on the Brandenburg soil and rapid on the Cabbart soil. Available water capacity is very low in both soils. The bedrock and the fractured porcelainite restrict the depth to which plant roots can penetrate.

Most areas are used for range. These soils generally are unsuited to trees, shrubs, and cultivated crops and to grasses and legumes for hay and pasture because of the slope and droughtiness. The key range plants are western wheatgrass, needleandthread, and little bluestem. Water erosion is a problem, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. The slope limits the use of machinery. Maintaining an adequate cover of the key plants helps to prevent denuding and excessive erosion. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

If buildings are constructed on these soils, the shrink-swell potential of the Cabbart soil is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock in the Cabbart soil is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. Because of the rapid permeability, the Brandenburg soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the contamination of ground water. The effluent in the absorption fields may follow bedding planes in the bedrock below the Cabbart soil and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soils tend to be deeper, are better sites for waste disposal than the upper parts. The buildings and absorption fields should be designed so that they conform to the natural slope of the land.

The land capability classification is VIIe. The range site of the Brandenburg soil is Very Shallow, and that of the Cabbart soil is Shallow. The productivity index of the unit for spring wheat is 0.

12—Hanly fine sandy loam, 0 to 3 percent slopes. This deep, level and nearly level, somewhat excessively drained soil is on flood plains and terraces. It is occasionally flooded. Individual areas range from about 5 to 75 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 3 inches thick. The substratum to a depth of about 60 inches is stratified. In sequence downward, it is brown loamy fine sand, light brownish gray very fine sandy loam, light brownish gray fine sand, light brownish gray loamy fine sand, light brownish gray loam, light brownish gray silty clay loam, and light brownish gray fine sand. In places the surface layer is loamy sand or sandy loam.

Included with this soil in mapping are small areas of the well drained Glendive soils. These soils make up about 10 to 20 percent of the unit. Also included are some areas where the substratum is gravelly loamy fine sand or sand.

Permeability is rapid in the Hanly soil. Runoff is slow. Available water capacity is low. Tilth is good.

Most areas are used as range. Some are used for cultivated crops, hay, or pasture. This soil is poorly suited to small grain and to grasses and legumes for hay and pasture. Controlling soil blowing and overcoming droughtiness are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and field windbreaks help to control soil blowing. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration. Growing rye and winter wheat helps to control soil blowing in fall, winter, and spring. Also, these crops can make the best use of the early season moisture supply. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are needleandthread and prairie sandreed. Intermediate and pubescent wheatgrasses and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control soil blowing.

This soil is suited to a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and the trees and shrubs are commonly affected by moisture stress. Irrigation helps to ensure the survival of seedlings. Little benefit is derived from fallowing the

season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Soils that are not subject to flooding generally are nearby.

The land capability classification is IVe. The range site is Thin Sands. The productivity index for spring wheat is 44.

14F—Baahish-Cabbart loams, 6 to 25 percent slopes. These moderately sloping to moderately steep soils are on terraces and truncated outwash plains. The deep, somewhat excessively drained Baahish soil is on the upper slopes. The shallow, well drained Cabbart soil is on the lower slopes. Individual areas range from about 10 to 70 acres in size. They are about 60 to 70 percent Baahish soil and 15 to 25 percent Cabbart soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Baahish soil has a dark brown loam surface layer about 5 inches thick. The subsoil is brown gravelly loam about 3 inches thick. The substratum to a depth of about 60 inches is very gravelly loam. It is pale brown in the upper part, light yellowish brown in the next part, and pale brown in the lower part.

Typically, the Cabbart soil has a light brownish gray loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the surface layer and subsoil are sandy loam or loamy sand.

Included with these soils in mapping are small areas of Amor, Vebar, and Wanagan soils. These included soils make up about 5 to 15 percent of the unit. Amor and Vebar soils are moderately deep. They are on side slopes. Wanagan soils are gravelly at a depth of 16 to 28 inches.

Permeability is moderate in the upper part of the Baahish soil and rapid in the lower part. It is moderate in the Cabbart soil. Runoff is rapid on both soils. Available water capacity is very low in the Cabbart soil and low in the Baahish soil. The bedrock and gravel restrict the depth to which plant roots can penetrate.

Most areas are used for range. These soils generally are unsuited to trees, shrubs, and cultivated crops and to grasses and legumes for hay and pasture because of the slope and droughtiness. The key range plants are western wheatgrass, needleandthread, and little bluestem. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

If buildings with basements are constructed on these soils, the depth to bedrock in the Cabbart soil is a limitation, but the rock generally is soft and can be easily excavated. Buildings and septic tank absorption fields should be designed so that they conform to the natural slope of the land. The effluent in septic tank absorption fields in areas of the Cabbart soil may follow bedding planes in the bedrock and surface downslope or contaminate ground water. Because of the rapid permeability, the Baahish soil readily absorbs but does not adequate filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the contamination of ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soils tend to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is VIIe. The range site of the Baahish soil is Very Shallow, and that of the Cabbart soil is Shallow. The productivity index of the unit for spring wheat is 0.

19F—Cabbart-Cherry silt loams, 9 to 35 percent slopes. These well drained soils are on uplands. The shallow, strongly sloping to steep Cabbart soil is on ridges and knobs. The deep, strongly sloping Cherry soil is on side slopes and foot slopes. Individual areas range from about 10 to 500 acres in size. They are about 40 to 50 percent Cabbart soil and 30 to 40 percent Cherry soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabbart soil has a light brownish gray silt loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the surface layer and subsoil are sandy loam.

Typically, the Cherry soil has a brown silt loam surface layer about 4 inches thick. The subsoil is about 22 inches thick. It is pale brown silt loam in the upper part and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale yellow silt loam. In some places the surface layer and subsoil are loam. In other places the surface layer is grayish brown or dark grayish brown. In a few areas it is silty clay loam.

Included with these soils in mapping are small areas of Amor, Brandenburg, and Chama soils and Badland. These included areas make up about 5 to 20 percent of the unit. Amor and Chama soils are moderately deep. They are on side slopes. Brandenburg soils have a substratum of fractured porcelainite. They are on ridges and hills. Badland is on shoulder slopes.

Permeability is moderate in the Cabbart soil and moderately slow in the Cherry soil. Runoff is rapid on both soils. Available water capacity is very low in the Cabbart soil and high in the Cherry soil. The bedrock in

the Cabbart soil restricts the depth to which plant roots can penetrate.

Most areas are used for range. These soils generally are unsuited to cultivated crops and to grasses and legumes for hay and pasture because of the slope and droughtiness of the Cabbart soil. The key range plants are western wheatgrass, needleandthread, and little bluestem. Water erosion is a problem, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to prevent denuding and excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Cherry soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabbart soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings with basements are constructed on these soils, the depth to bedrock in the Cabbart soil is a limitation, but the rock generally is soft and can be easily excavated. The shrink-swell potential of both soils is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. Buildings and septic tank absorption fields should be designed so that they conform to the natural slope of the land. The effluent in septic tank absorption fields may follow bedding planes in the bedrock below the Cabbart soil and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The moderately slow permeability of the Cherry soil is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field. The lower parts of the landscape, where the soils tend to be deeper and where the Cherry soil is located, are better sites for waste disposal than the upper parts.

The land capability classification of the Cabbart soil is VIIe, and that of the Cherry soil is IVe. The range site of the Cabbart soil is Shallow, and that of the Cherry soil is Silty. The productivity index of the unit for spring wheat is 0.

20—Chama silt loam, 1 to 3 percent slopes. This moderately deep, nearly level, well drained soil is on summits and side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 80 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsoil is silt loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is light gray silt loam about 10 inches thick. Below this is soft siltstone bedrock. In some places the depth to lime is 10 inches or more. In other places the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Cabba and Golva soils. These soils make up about 5 to 15 percent of the unit. Cabba soils are shallow. They are on ridges and knobs. Golva soils are deep. They are on foot slopes.

Permeability is moderate in the Chama soil. Runoff is slow. Available water capacity is low. The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling soil blowing. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to control soil blowing. Conservation tillage also helps to provide food and nesting cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass and needleandthread. Western and crested wheatgrass and sweetclover are suitable hay and pasture plants. Soil blowing is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control soil blowing.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be

deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 74.

20B—Chama silt loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsoil is silt loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is light gray silt loam about 10 inches thick. Below this is soft siltstone bedrock. In some places the depth to lime is 10 inches or more. In other places the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Cabba, Golva, and Wayden soils. These soils make up about 5 to 20 percent of the unit. Cabba and Wayden soils are shallow. They are on ridges and knobs. Golva soils are deep. They are on foot slopes. Also included, on side slopes, are some areas of soils that have fractured porcelainite at a depth of 20 to 40 inches.

Permeability is moderate in the Chama soil. Runoff is medium. Available water capacity is low. The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of soil blowing and water erosion are moderate. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling erosion. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass and needleandthread. Soil blowing and water erosion are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 64.

21C—Chama-Cabba silt loams, 3 to 9 percent slopes. These gently sloping and moderately sloping, well drained soils are on uplands. The moderately deep Chama soil is on side slopes. The shallow Cabba soil is on ridges and knobs. Individual areas range from about 10 to 50 acres in size. They are about 45 to 55 percent Chama soil and 30 to 40 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Chama soil has a grayish brown silt loam surface layer about 4 inches thick. The subsoil is silt loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is light gray silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the depth to lime is 10 inches or more.

Typically, the Cabba soil has a light brownish gray silt loam surface layer about 6 inches thick. The substratum is light gray silt loam about 9 inches thick. Below this is soft siltstone bedrock.

Included with these soils in mapping are small areas of Brandenburg, Golva, and Vebar soils. These included soils make up about 5 to 15 percent of the unit. Brandenburg soils have a substratum of fractured porcelainite. They are on ridges and hills. Golva soils are deep. They are on foot slopes. Vebar soils are moderately deep. They are intermingled with areas of the Chama soil.

Permeability is moderate in the Chama and Cabba soils. Runoff is medium. Available water capacity is low in the Chama soil and very low in the Cabba soil. The bedrock underlying both soils restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. These soils are suited to small grain and flax and to grasses and legumes for hay and pasture. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. The main

concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling erosion. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves or helps to maintain fertility and tilth and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on these soils are western wheatgrass, needleandthread, and little bluestem. Intermediate and pubescent wheatgrass, smooth bromegrass, and sweetclover are suitable hay and pasture plants. Soil blowing and water erosion are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Chama soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabba soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soils tend to be deeper and where the Chama soil is located, are better sites for waste disposal than the upper parts.

The land capability classification of the Chama soil is IIIe, and that of the Cabba soil is VIe. The range site of the Chama soil is Silty, and that of the Cabba soil is Shallow. The productivity index of the unit for spring wheat is 40.

24B—Cherry silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on foot slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is about 22 inches thick. It is pale brown silt loam in the upper part and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale yellow silt loam. In some areas the surface layer is silty clay loam. In other areas it is grayish brown and is 5 to 8 inches thick. In places the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Belfield and Chama soils. These soils make up about 5 to 15 percent of the unit. Belfield soils have an alkali subsoil. They are intermingled with areas of the Cherry soil. Chama soils are moderately deep. They are on rises.

Permeability is moderately slow in the Cherry soil. Runoff is medium. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are maintaining tilth and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration.

The key range plants on this soil are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 67.

24C—Cherry silt loam, 6 to 9 percent slopes. This deep, moderately sloping, well drained soil is on foot

slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is about 22 inches thick. It is pale brown silt loam in the upper part and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale yellow silt loam. In some places the surface layer is silty clay loam. In other places it is grayish brown and is 5 to 8 inches thick. In some areas the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Belfield and Lawther soils. These soils make up about 5 to 10 percent of the unit. They are intermingled with areas of the Cherry soil. Belfield soils have an alkali subsoil. Lawther soils have a silty clay loam surface layer and a silty clay subsoil.

Permeability is moderately slow in the Cherry soil. Runoff is rapid. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. This soil is suited to small grain and flax and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is severe. The main concerns in managing cultivated areas are maintaining tilth and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control water erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration.

The key range plants on this soil are western wheatgrass, needleandthread, and green needlegrass. Intermediate and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIIe. The range site is Silty. The productivity index for spring wheat is 55.

26—Dimmick silty clay, loamy substratum. This deep, level, very poorly drained soil is in basins and depressions on uplands. It is subject to ponding. Individual areas are irregular in shape and range from about 5 to 200 acres in size.

Typically, the surface soil is gray, mottled silty clay about 30 inches thick. The next layer is light gray, mottled silty clay about 11 inches thick. The upper part of the substratum is white, mottled silty clay loam. The lower part to a depth of about 60 inches is light gray, mottled loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Grassna Variant soils. These soils make up about 5 to 10 percent of the unit.

Permeability is very slow in the Dimmick soil. Runoff is ponded. A seasonal high water table is 1 foot above to 2 feet below the surface. Available water capacity is high. The surface layer should be tilled when it is neither too wet nor too dry. It is sticky when wet and tends to become cloddy when dry. Tilth is poor.

Most areas are used for range or wetland wildlife habitat. Some are used for cultivated crops. This soil is poorly suited to small grain and to grasses and legumes for hay and pasture because of the wetness. A drainage system can improve the suitability for crops, pasture, and hay. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. In undrained areas crops are planted and harvested in about 2 to 4 years out of 10. In areas that are drained and cultivated, the main management concerns are improving tilth and controlling soil blowing. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, and stripcropping help to control soil blowing. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

This soil and the ponded water provide feeding, breeding, and rearing areas for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural water level and preventing siltation.

The key range plants on this soil are slough sedge, rivergrass, and prairie cordgrass. Reed canarygrass and alfalfa are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range is grazed during wet periods. They can be overcome by deferring grazing when the soil is wet.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but undrained areas generally are unsuited. The wetness is a critical limitation affecting survival, growth, and vigor. The grasses and weeds growing on this soil are abundant and persistent.

Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

This soil generally is unsuited to buildings and septic tank absorption fields because of the ponding. Better sites generally are nearby.

The land capability classification is IIIw. The range site is Wetland. The productivity index for spring wheat is 40 to 70, depending on the degree of drainage.

35F—Flasher loamy sand, 15 to 45 percent slopes. This shallow, moderately steep to very steep, somewhat excessively drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from about 10 to 1,000 acres in size.

Typically, the surface layer is light brownish gray loamy sand about 6 inches thick. The substratum is light gray loamy sand about 5 inches thick. Below this is soft sandstone bedrock. In places the surface layer and substratum are fine sandy loam.

Included with this soil in mapping are small areas of Beisigl and Vebar soils and Badland. These areas make up about 5 to 25 percent of the unit. Beisigl and Vebar soils are moderately deep. They are on side slopes. Badland is on knobs and side slopes. Also included, on the top of Sentinel Butte, are some areas of nearly level to moderately sloping soils that have a silt loam surface layer and subsoil. On the top of Square Butte are some included areas of sandstone rock outcrop and of nearly level to moderately sloping soils that have hard sandstone at a depth of about 18 inches.

Permeability is rapid in the Flasher soil. Runoff also is rapid. Available water capacity is very low. The bedrock restricts the depth to which plant roots can penetrate.

Most areas are used for range. This soil generally is unsuited to cultivated crops, to trees and shrubs, and to grasses and legumes for hay and pasture because of droughtiness and the slope. The key range plants are needleandthread, prairie sandreed, and little bluestem. Soil blowing and water erosion are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. The slope limits the use of machinery. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil generally is unsuited to buildings and septic tank absorption fields because of the slope. Better sites generally are nearby.

The land capability classification is VIIe. The range site is Shallow. The productivity index for spring wheat is 0.

37—Golva silt loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on foot slopes and toe slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 200 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is about 26 inches thick. It is grayish brown silty clay loam in the upper part, pale brown silt loam in the next part, and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is light gray silty clay loam. In places the dark color of the surface layer extends to a depth of more than 16 inches. In some areas the subsoil is silty clay. In other areas the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Amor, Chama, Lawther, and Sen soils. These soils make up about 5 to 15 percent of the unit. Amor, Chama, and Sen soils are moderately deep. They are on side slopes. Lawther soils have a silty clay loam surface layer. They are intermingled with areas of the Golva soil.

Permeability is moderate in the Golva soil. Runoff is slow. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers (fig. 7) and to grasses and legumes for hay and pasture. The hazards of soil blowing and water erosion are slight. The main concerns in managing cultivated areas are maintaining tilth and fertility and controlling erosion in areas where runoff concentrates. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control local erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain or improve fertility and tilth and increases the rate of water infiltration.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIc. The range site is Silty. The productivity index for spring wheat is 98.

Figure 7.—An area of Golva silt loam, 1 to 3 percent slopes, used for sunflowers.

37B—Golva silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on foot slopes and toe slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is about 26 inches thick. It is grayish brown silty clay loam in the upper part, pale brown silt loam in the next part, and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is light gray silty clay loam. In places the dark color of the surface layer extends to a depth of more than 16 inches. In some areas the surface layer is light brownish gray. In other areas the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Chama, Sen, and Vebar soils on side slopes. These soils make up about 5 to 10 percent of the unit. They are moderately deep.

Permeability is moderate in the Golva soil. Runoff is medium. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are maintaining tilth and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain or improve fertility and tilth and increases the rate of water infiltration.

The key range plants on this soil are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 88.

41—Grail silty clay loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on foot slopes and toe slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 50 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 9 inches thick. The subsoil is about 37 inches thick. It is dark grayish brown silty clay in the upper part, light brownish gray silty clay in the next part, and pale brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale brown silty clay loam. In some places the surface layer and subsoil are silt loam. In other places the dark color of the surface layer extends to a depth of only 8 to 16 inches.

Included with this soil in mapping are small areas of Belfield and Lawther soils. These soils make up about 5 to 15 percent of the unit. They are intermingled with areas of the Grail soil. Belfield soils have an alkali subsoil. Lawther soils have tongues of the surface layer in the subsoil. Also included are some areas of saline soils.

Permeability is moderately slow in the Grail soil. Runoff is slow. The soil receives runoff from the adjacent soils. Available water capacity is high. The surface layer should be tilled when it is neither too wet nor too dry. It is sticky when wet and tends to become cloddy when dry. Tilth is fair.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main concerns in managing cultivated areas are maintaining tilth and controlling erosion in areas where runoff concentrates. A system of conservation tillage that leaves crop residue on the surface and grassed waterways where runoff concentrates help to control local erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, green needlegrass, and big bluestem. Intermediate and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIc. The range site is Overflow. The productivity index for spring wheat is 99.

45—Havre silt loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained soil is on flood plains and terraces. It is occasionally flooded. Individual areas are irregular in shape and range from about 5 to 75 acres in size.

Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The upper part of the substratum is light gray silt loam. The next part is light brownish gray silt loam. The lower part to a depth of about 60 inches is light brownish gray loam. In places the soil is only rarely flooded.

Included with this soil in mapping are small areas of Glendive and Korchea soils. These soils make up about 5 to 20 percent of the unit. They are intermingled with areas of the Havre soil. Glendive soils have a fine sandy loam surface layer. Korchea soils have a grayish brown surface layer.

Permeability is moderate in the Havre soil. Runoff is slow. Available water capacity is high. Tilth is good.

Most areas are used for range. Some are used for cultivated crops, hay, or pasture. This soil is suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. The main concerns in managing cultivated areas are maintaining tilth and controlling soil blowing. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, and stripcropping help to control soil blowing. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Soils that are not subject to flooding generally are nearby.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 84.

46—Glendive fine sandy loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained soil is on flood plains and terraces. It is occasionally flooded. Individual areas are irregular in shape and range from about 5 to 75 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 5 inches thick. The substratum to a depth of about 60 inches is stratified. It is grayish brown and light brownish gray loam in the upper part, grayish brown and light brownish gray silt loam in the next part, and light brownish gray and light gray fine sandy loam in the lower part.

Included with this soil in mapping are small areas of Hanly and Havre soils. These soils make up about 5 to 15 percent of the unit. They are intermingled with areas of the Glendive soil. Hanly soils are somewhat excessively drained. Havre soils have a silt loam surface layer.

Permeability is moderately rapid in the Glendive soil. Runoff is slow. Available water capacity is moderate. Tilth is good.

Most areas are used for range. Some are used for cultivated crops, hay, or pasture. This soil is suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is severe, and the hazard of water erosion is slight. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling soil blowing. A system of conservation tillage that leaves crop residue on the surface and field windbreaks help to control soil blowing. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration. Growing rye and winter wheat helps to control soil blowing in fall, winter, and spring. Also, these crops can make the best use of the early season moisture supply. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass, needleandthread, and prairie sandreed. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Soils that are not subject to flooding generally are nearby.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 65.

47—Korchea silt loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained soil is on flood plains and terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from about 5 to 75 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The substratum extends to a depth of 60 inches or more. In sequence downward, it is pale brown very fine sandy loam, grayish brown silt loam, light

brownish gray silt loam, grayish brown and brown silt loam, and pale brown silt loam. In some places the surface layer is loam. In other places it is light brownish gray.

Included with this soil in mapping are small areas of Cherry soils on upland foot slopes. These soils make up about 5 to 20 percent of the unit. Also included are some areas of soils that have a fine sandy loam surface layer and substratum.

Permeability is moderate in the Korchea soil. Runoff is slow. Available water capacity is high. Tilth is good.

Most areas are used for range. Some are used for cultivated crops, hay, or pasture. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of soil blowing and water erosion are slight. The main concern in managing cultivated areas is maintaining tilth and fertility. A system of conservation tillage that leaves crop residue on the surface helps to control erosion during floods. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, needleandthread, and green needlegrass. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Soils that are not subject to flooding generally are nearby.

The land capability classification is IIc. The range site is Silty. The productivity index for spring wheat is 88.

52B—Belfield loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, alkali soil is on flats in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface soil is loam about 11 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The next layer is brown clay loam about 10 inches thick. It has grayish brown silt coatings in the upper part. The subsoil is about 29 inches thick. It is very pale brown clay loam in the upper part, light gray clay loam in the next part, and light gray loam in the lower part. The substratum to a depth of about 60 inches is light gray fine sandy loam. In places the substratum is clay loam, silty clay loam, or silty clay.

Included with this soil in mapping are small areas of the moderately well drained Absher soils. These soils make up about 5 to 15 percent of the unit. They are intermingled with areas of the Belfield soil. Also included are some areas of soils that have soft bedrock at a depth of 20 to 40 inches.

Permeability is slow in the Belfield soil. Runoff is medium. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. Some are used for range. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main concerns in managing cultivated areas are maintaining tilth and fertility and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration.

The key range plants on this soil are western wheatgrass and green needlegrass. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Individual trees and shrubs vary in height, density, and vigor, which are affected by the restricted root development in the subsoil and the reduced amount of available water resulting from the salts in the soil.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIIe. The range site is Clayey. The productivity index for spring wheat is 66.

55—Wanagan loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and outwash plains. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is loam about 11

inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is very pale brown and brown very gravelly sandy clay loam. The upper part of the substratum is pale brown very gravelly fine sandy loam. The lower part to a depth of about 60 inches is light brownish gray extremely gravelly loam. In places the dark color of the surface layer extends to a depth of 16 inches or more.

Included with this soil in mapping are small areas of Shambo soils. These soils make up about 5 to 15 percent of the unit. They are intermingled with areas of the Wanagan soil. Their substratum is loam to a depth of about 42 inches.

Permeability is moderate in the Wanagan soil. Runoff is slow. Available water capacity is moderate. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main concerns in managing cultivated areas are maintaining tilth and fertility and overcoming droughtiness. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control local erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and overcome droughtiness.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIs. The range site is Silty. The productivity index for spring wheat is 63.

55B—Wanagan loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on terraces and outwash plains. Individual areas are irregular in shape and range from about 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is loam about 11 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is very pale brown and brown very gravelly sandy clay loam. The upper part of the substratum is pale brown very gravelly fine sandy loam. The lower part to a depth of about 60 inches is light brownish gray extremely gravelly loam. In some places the substratum is silt loam. In other places the dark color of the surface layer extends to a depth of 16 inches or more.

Included with this soil in mapping are small areas of Baahish and Chama soils. These soils make up about 5 to 20 percent of the unit. Baahish soils are gravelly at a depth of about 5 inches. They are on knobs and terrace escarpments. Chama soils are moderately deep. They are on side slopes. Also included are some moderately sloping areas.

Permeability is moderate in the Wanagan soil. Runoff is medium. Available water capacity is moderate. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate

permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 48.

57C—Moreau-Wayden-Absher complex, 3 to 9 percent slopes. These soils are on uplands. The moderately deep, gently sloping and moderately sloping, well drained Moreau soil and the deep, gently sloping, moderately well drained, alkali Absher soil are on flats. The shallow, gently sloping and moderately sloping, well drained Wayden soil is on rises. Individual areas range from about 10 to 50 acres in size. They are about 40 to 50 percent Moreau soil, 30 to 40 percent Wayden soil, and 15 to 20 percent Absher soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Moreau soil has a grayish brown silty clay loam surface layer about 5 inches thick. The subsoil is silty clay about 12 inches thick. It is grayish brown in the upper part and pale yellow in the lower part. The substratum is light brownish gray silty clay about 10 inches thick. Below this is soft siltstone and shale bedrock.

Typically, the Wayden soil has a light olive gray silty clay surface layer about 5 inches thick. The substratum also is light olive gray silty clay. It is about 6 inches thick. Below this is soft shale bedrock.

Typically, the Absher soil has a light brownish gray loam surface layer about 2 inches thick. The subsoil is about 56 inches thick. In sequence downward, it is grayish brown silty clay, grayish brown clay loam, light brownish gray clay loam, and light brownish gray silty clay loam. The substratum to a depth of about 60 inches is light brownish gray clay loam.

Included with these soils in mapping are small areas of Cherry and Lawther soils. These included soils make up about 5 to 15 percent of the unit. They are deep and do not have an alkali subsoil. They are intermingled with areas of the Absher soil. Also included are some areas of Badland.

Permeability is slow in the Moreau and Wayden soils and very slow in the Absher soil. Runoff is medium on the Moreau and Absher soils and rapid on the Wayden soil. Available water capacity is low in the Moreau and Absher soils and very low in the Wayden soil. Salts in the Absher soil restrict the amount of water available to plants. The bedrock underlying the Moreau and Wayden soils and the dense subsoil of the Absher soil restrict the depth to which plant roots can penetrate. The surface layer of the Moreau and Wayden soils should be tilled when it is neither too wet nor too dry. It is sticky when wet and tends to be cloddy when dry. Tilth is poor.

Most areas are used for range. Some are used for cultivated crops, hay, or pasture. These soils are poorly suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. The main concerns in managing cultivated areas are improving tilth, overcoming droughtiness, and controlling erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control soil erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on these soils are western wheatgrass, blue grama, and little bluestem. Western, slender, and crested wheatgrass and sweetclover are suitable hay and pasture plants. Water erosion and soil blowing are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss. Stock water ponds constructed in areas of the Absher soil frequently contain salty water.

The Moreau soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Absher and Wayden soils generally are unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Individual trees and shrubs vary in height, density, and vigor, which are affected by the restricted root development in all three soils and the reduced amount of available water resulting from the salts in the Absher soil.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock in the Moreau and Wayden soils is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock below the Moreau and Wayden soils and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. It also helps to overcome the restricted permeability of the Moreau and Absher soils.

The land capability classification of the Moreau soil is IVe, that of the Wayden soil is VIe, and that of the Absher soil is VIs. The range site of the Moreau soil is Clayey, that of the Wayden soil is Shallow Clay, and that of the Absher soil is Thin Claypan. The productivity index of the unit for spring wheat is 33.

72—Parshall fine sandy loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained

soil is on toe slopes in the uplands. Individual areas range from about 5 to 70 acres in size.

Typically, the surface soil is dark grayish brown fine sandy loam about 10 inches thick. The subsoil is brown fine sandy loam about 29 inches thick. The substratum to a depth of about 60 inches is very pale brown fine sandy loam. In places the dark color of the surface soil extends only to a depth of 8 to 16 inches.

Included with this soil in mapping are small areas of the moderately deep Vebar soils on side slopes. These soils make up about 5 to 20 percent of the unit. Also included are some areas of soils that have a loamy sand or gravelly loamy sand substratum and soils that have a loam surface layer and subsoil.

Permeability is moderately rapid in the Parshall soil. Runoff is slow. Available water capacity is moderate. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of water erosion is slight, and the hazard of soil blowing is severe. Controlling soil blowing, overcoming droughtiness, and maintaining tilth are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are prairie sandreed, needleandthread, and western wheatgrass. Intermediate, crested, and pubescent wheatgrass and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

This soil is well suited to buildings and septic tank absorption fields. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 69.

76B—Regent silty clay loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 5 inches thick. The subsoil is silty clay about 20 inches thick. It is brown in the upper part and pale brown in the lower part. The substratum is light gray silty clay about 8 inches thick. Below this is soft shale bedrock. In places the subsoil does not have an accumulation of clay.

Included with this soil in mapping are small areas of Lawther and Wayden soils. These soils make up about 10 to 15 percent of the unit. Lawther soils are deep. They are on foot slopes. Wayden soils are shallow. They are on ridges and knobs.

Permeability is slow in the Regent soil. Runoff is medium. Available water capacity is moderate. The bedrock restricts the depth to which plant roots can penetrate. The surface layer should be tilled when it is neither too wet nor too dry. It is sticky when wet and tends to become cloddy when dry. Tilth is fair.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are improving tilth, overcoming droughtiness, and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass and green needlegrass. Intermediate, pubescent, and crested wheatgrass, alfalfa, and sweetclover are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural

damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIe. The range site is Clayey. The productivity index for spring wheat is 73.

80B—Absher loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, moderately well drained, alkali soil is on flats in the uplands. Individual areas are irregular in shape and range from about 5 to 200 acres in size.

Typically, the surface layer is light brownish gray loam about 2 inches thick. The subsoil is about 56 inches thick. In sequence downward, it is grayish brown silty clay, grayish brown clay loam, light brownish gray clay loam, and light brownish gray silty clay loam. The substratum to a depth of about 60 inches is light brownish gray clay loam. In some places the subsoil is silt loam. In other places the surface layer is 3 to 7 inches thick. In a few areas soft bedrock is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Belfield, Cabba, Lawther, and Wayden soils. These soils make up about 5 to 20 percent of the unit. Belfield soils do not have salts within a depth of 16 inches. Lawther soils do not have a dense, alkali subsoil. Belfield and Lawther soils are intermingled with areas of the Absher soil. Cabba and Wayden soils are shallow. They are on knobs and ridges.

Permeability is very slow in the Absher soil. Runoff is medium. Available water capacity is low. Salts in the soil reduce the amount of water available to plants. The dense subsoil restricts the depth and extent to which plant roots can penetrate.

Most areas are used for range (fig. 8). This soil generally is unsuited to cultivated crops, trees, and shrubs because of the salts, the dense subsoil, and the high content of sodium. The key range plants are western wheatgrass and green needlegrass. Crested, slender, and western wheatgrass and sweetclover are suitable hay and pasture plants. The dense, alkali subsoil and the salts are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to prevent denuding. Stock water ponds constructed in areas of this soil frequently contain salty water.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The very slow permeability is a limitation in septic tank absorption fields. A mound system helps to overcome this limitation.

The land capability classification is VIs. The range site is Thin Claypan. The productivity index for spring wheat is 0.

81F—Cabbart-Rock outcrop complex, 15 to 120 percent slopes. This map unit occurs as areas of a moderately steep to very steep, well drained, shallow Cabbart soil intermingled with areas of Rock outcrop (fig. 9). The unit is on uplands. The Cabbart soil is on ridges and side slopes. The Rock outcrop is on shoulder slopes and forms a characteristic rimrock. Individual areas range from about 20 to 1,000 acres in size. They are about 45 to 55 percent Cabbart soil and 30 to 40 percent Rock outcrop. The Cabbart soil and the Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabbart soil has a light brownish gray silt loam surface layer about 4 inches thick. The subsoil is white silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the soil has a substratum of fractured porcelainite.

Typically, the Rock outcrop is a rimrock of limestone, sandstone, or porcelainite.

Included with this unit in mapping are small areas of Cherry and Lawther soils. These soils make up about 5 to 15 percent of the unit. They are deep. Cherry soils are on side slopes. Lawther soils are on foot slopes. Also included, on foot slopes, are some areas of deep soils that are dark to a depth of 16 inches or more.

Permeability is moderate in the Cabbart soil. Runoff is rapid. Available water capacity is very low. The bedrock restricts the depth to which plant roots can penetrate.

Most areas are used for range. This unit generally is unsuited to cultivated crops, to trees and shrubs, and to grasses and legumes for hay and pasture because of the slope, stoniness, and droughtiness. The key range plants are western wheatgrass, needleandthread, and little bluestem. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This unit generally is unsuited to buildings and septic tank absorption fields. Better sites generally are nearby.

The land capability classification of the Cabbart soil is VIIe, and that of the Rock outcrop is VIIIs. The range site of the Cabbart soil is Shallow. The Rock outcrop is not assigned to a range site. The productivity index of the unit for spring wheat is 0.

83F—Badland-Cherry complex, 6 to 75 percent slopes. This map unit occurs as areas of Badland

Figure 8.—An area of Absher loam, 1 to 6 percent slopes, used for range. This soil has a high content of sodium and a dense subsoil. Bare spots and sparse vegetation are common.

intermingled with areas of a deep, moderately sloping and strongly sloping, well drained Cherry soil. The unit is on uplands. The Cherry soil is on side slopes and foot slopes. The Badland is on knobs, buttes, and escarpments. Individual areas range from about 10 to 2,000 acres in size. They are about 50 to 60 percent Badland and 20 to 30 percent Cherry soil. The Badland and the Cherry soil occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Badland consists of exposed, eroding, soft, silty and clayey, barren bedrock. It generally is on south-facing slopes.

Typically, the Cherry soil has a brown silt loam surface layer about 4 inches thick. The subsoil is about 22 inches thick. It is pale brown silt loam in the upper part and light gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale yellow silt loam. In places the surface layer and subsoil are loam.

Included with this unit in mapping are small areas of Absher, Brandenburg, Cabbart, and Flasher soils. These soils make up about 5 to 20 percent of the unit. Absher soils have a dense, alkali subsoil. They are on toe slopes. Brandenburg soils have a substratum of fractured porcelainite. Cabbart and Flasher soils are shallow. Brandenburg, Cabbart, and Flasher soils are on ridges and knobs.

Permeability is moderately slow in the Cherry soil. Runoff is rapid. Available water capacity is high.

Most areas are used for range. This unit generally is unsuited to trees and shrubs, to cultivated crops, and to

Figure 9.—An area of Cabbart-Rock outcrop complex, 15 to 120 percent slopes.

grasses and legumes for hay and pasture because of the slope and the erosion hazard. The key range plants are western wheatgrass, needleandthread, and green needlegrass. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This unit generally is unsuited to buildings and septic tank absorption fields. Better sites generally are nearby.

The land capability classification of the Badland is VIIIe, and that of the Cherry soil is IVe. The Badland is not assigned to a range site. The range site of the Cherry soil is Silty. The productivity index of the unit for spring wheat is 0.

84—Lawther silty clay loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on toe slopes and foot slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 5 inches thick. The subsoil is about 43 inches thick. It is light brownish gray. It is silty clay in the upper part and silty clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray silty clay. In some places the subsoil is silt loam. In other places the surface layer is light brownish gray.

Included with this soil in mapping are small areas of the alkali Belfield soils. These soils make up about 5 to 15 percent of the unit. They are intermingled with areas of the Lawther soil.

Permeability is slow in the Lawther soil. Runoff also is slow. Available water capacity is high. The surface layer should be tilled when it is neither too wet nor too dry. It is sticky when wet and tends to become cloddy when dry. Tilth is fair.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main concern in managing cultivated areas is improving tilth and fertility. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control local erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass and green needlegrass. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIs. The range site is Clayey. The productivity index for spring wheat is 89.

84B—Lawther silty clay loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on foot slopes and toe slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 200 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 5 inches thick. The subsoil is about 43 inches thick. It is light brownish gray. It is silty clay in the upper part and silty clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray silty clay. In some places the subsoil is silt loam. In other places the surface layer is light brownish gray.

Included with this soil in mapping are small areas of Absher and Wayden soils. These soils make up about 5 to 20 percent of the unit. Absher soils have an alkali subsoil. They are intermingled with areas of the Lawther soil. Wayden soils are shallow. They are on knobs.

Permeability is slow in the Lawther soil. Runoff is medium. Available water capacity is high. The surface layer should be tilled when it is neither too wet nor too dry. It is sticky when wet and tends to become cloddy when dry. Tilth is fair.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. This soil is suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The main concerns in managing cultivated areas are improving tilth and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control erosion. Conservation tillage and grassed waterways also help to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

The key range plants on this soil are western wheatgrass and green needlegrass. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIe. The range site is Clayey. The productivity index for spring wheat is 69.

88—Sen silt loam, 1 to 3 percent slopes. This moderately deep, nearly level, well drained soil is on side slopes and summits in the uplands. Individual areas are irregular in shape and range from about 5 to 50 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is silt loam about 27 inches thick. It is brown in the upper part, pale brown in the next part, and white in the lower part. The substratum is pale yellow silt loam about 5 inches thick. Below this is soft siltstone bedrock. In some places the

surface layer is calcareous. In other places the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Golva, Grassna, and Shambo soils on foot slopes. These soils make up about 5 to 10 percent of the unit. They are deep.

Permeability is moderate in the Sen soil. Runoff is slow. Available water capacity is moderate. The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main concerns in managing cultivated areas are maintaining tilth and fertility and overcoming droughtiness. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control local erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIc. The range site is Silty. The productivity index for spring wheat is 86.

88B—Sen silt loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is silt loam about 27 inches thick. It is brown in the upper part, pale brown in the next part, and white in the lower part. The substratum is pale yellow silt loam about 5 inches thick. Below this is soft siltstone bedrock. In some places the surface layer is calcareous. In other places the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Cabba, Golva, and Shambo soils. These soils make up about 5 to 10 percent of the unit. Cabba soils are shallow. They are on ridges and knobs. Golva and Shambo soils are deep. They are on foot slopes.

Permeability is moderate in the Sen soil. Runoff is medium. Available water capacity is moderate. The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass, green needlegrass, and needleandthread. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The

lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 75.

89—Shambo loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and on upland flats. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is grayish brown loam about 5 inches thick. The subsoil is about 31 inches thick. It is brown loam in the upper part, brown silt loam in the next part, and light gray loam in the lower part. The upper part of the substratum is light gray loam. The lower part to a depth of about 60 inches is light brown gravelly loam. In places the dark color of the surface layer extends to a depth of more than 16 inches.

Included with this soil in mapping are small areas of Amor and Wanagan soils. These soils make up about 5 to 20 percent of the unit. Amor soils are moderately deep. They are on side slopes. Wanagan soils are gravelly at a depth of 16 to 28 inches. They are intermingled with areas of the Shambo soil. Also included are some areas of soils that have a fine sandy loam surface layer and subsoil and a gravelly substratum.

Permeability is moderate in the Shambo soil. Runoff is slow. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazards of water erosion and soil blowing are slight. The main concern in managing cultivated areas is maintaining tilth and fertility. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control local erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration.

No major hazards or limitations affect the use of this soil for range. The key range plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIc. The range site is Silty. The productivity index for spring wheat is 83.

89B—Shambo loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on terraces and on upland flats. Individual areas are irregular in shape and range from about 10 to 50 acres in size.

Typically, the surface layer is grayish brown loam about 5 inches thick. The subsoil is about 31 inches thick. It is brown loam in the upper part, brown silt loam in the next part, and light gray loam in the lower part. The upper part of the substratum is light gray loam. The lower part to a depth of about 60 inches is light brown gravelly loam. In some places the surface layer and subsoil are silt loam or fine sandy loam. In other places the dark color of the surface layer extends to a depth of more than 16 inches.

Included with this soil in mapping are small areas of Amor, Sen, and Wanagan soils. These soils make up about 5 to 20 percent of the unit. Amor and Sen soils are moderately deep. They are on side slopes. Wanagan soils are gravelly at a depth of 16 to 28 inches. They are intermingled with areas of the Shambo soil.

Permeability is moderate in the Shambo soil. Runoff is medium. Available water capacity is high. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are maintaining tilth and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration.

The key range plants on this soil are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 79.

97B—Vebar fine sandy loam, 1 to 6 percent slopes. This moderately deep, nearly level and gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 50 acres in size.

Typically, the surface soil is grayish brown fine sandy loam about 11 inches thick. The subsoil is about 15 inches thick. It is brown fine sandy loam in the upper part, pale brown sandy loam in the next part, and light gray fine sandy loam in the lower part. The substratum is light gray fine sandy loam about 12 inches thick. Below this is soft sandstone bedrock. In places the subsoil is loam. In a few areas, particularly in the vicinity of Beach, the bedrock is soft siltstone or shale.

Included with this soil in mapping are small areas of Beisigl, Cabba, Flasher, and Parshall soils. These soils make up about 10 to 20 percent of the unit. Beisigl soils have a loamy sand surface layer. They are intermingled with areas of the Vebar soil. Cabba and Flasher soils are shallow. They are on knobs and knolls. Parshall soils are deep. They are in swales.

Permeability is moderately rapid in the Vebar soil. Runoff is slow. Available water capacity is moderate. The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. This soil is suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is severe, and the hazard of water erosion is slight. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling soil blowing. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, and stripcropping help to control soil blowing. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Growing rye or winter wheat helps to control soil blowing in fall, winter, and spring. Also, these crops can make the best use of the early season moisture supply Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass, needleandthread, and prairie sandreed. Intermediate and pubescent wheatgrass, sand bluestem, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control soil blowing.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is somewhat droughty, and the trees and shrubs are commonly affected by moisture stress, particularly during the establishment period. Irrigation helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the moderate available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings with basements are constructed on this soil, the depth to bedrock is a limitation, but the rock generally is soft and can be easily excavated. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 59.

97C—Vebar fine sandy loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 50 acres in size.

Typically, the surface soil is grayish brown fine sandy loam about 11 inches thick. The subsoil is about 15 inches thick. It is brown fine sandy loam in the upper part, pale brown sandy loam in the next part, and light gray fine sandy loam in the lower part. The substratum is light gray fine sandy loam about 12 inches thick. Below this is soft sandstone bedrock. In a few places, particularly in the vicinity of Beach, the bedrock is soft siltstone or shale. In some areas the subsoil is loam.

Included with this soil in mapping are small areas of Beisigl, Flasher, and Parshall soils. These soils make up about 5 to 20 percent of the unit. Beisigl soils have a loamy sand surface layer. They are intermingled with areas of the Vebar soil. Flasher soils are shallow. They are on knobs and knolls. Parshall soils are deep. They are in swales.

Permeability is moderately rapid in the Vebar soil. Runoff is medium. Available water capacity is moderate.

The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. This soil is poorly suited to small grain, flax, and sunflowers. It is suited to grasses and legumes for hay and pasture. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are overcoming droughtiness and controlling erosion. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Growing rye or winter wheat helps to control soil blowing in fall, winter, and spring. Also, these crops can make the best use of the early season moisture supply. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass, needleandthread, and prairie sandreed. Intermediate and pubescent wheatgrass, sand bluestem, and alfalfa are suitable hay and pasture plants. Soil blowing and water erosion are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key range plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is somewhat droughty, and the trees and shrubs are commonly affected by moisture stress, particularly during the establishment period. Irrigation helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the moderate available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings with basements are constructed on this soil, the depth to bedrock is a limitation, but the rock generally is soft and can be easily excavated. The sides of shallow excavations, such as those for basements, tend to cave unless they are shored. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IVe. The range site is Sandy. The productivity index for spring wheat is 46.

99C—Beisigl-Flasher-Vebar complex, 3 to 9 percent slopes. These soils are on uplands. The moderately deep, somewhat excessively drained, gently sloping Beisigl soil is on the upper side slopes. The shallow, somewhat excessively drained, moderately sloping Flasher soil is on ridges and knobs. The moderately deep, well drained, gently sloping Vebar soil is on the lower side slopes. Individual areas range from about 10 to 50 acres in size. They are about 25 to 35 percent Beisigl soil, 25 to 35 percent Flasher soil, and 15 to 25 percent Vebar soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Beisigl soil has a loamy sand surface layer about 9 inches thick. This layer is grayish brown in the upper part and light brownish gray in the lower part. The subsoil is loamy sand about 25 inches thick. It is light brownish gray in the upper part and light gray in the lower part. Below this is soft sandstone bedrock. In places the depth to bedrock is 40 to 60 inches.

Typically, the Flasher soil has a light brownish gray loamy sand surface layer about 6 inches thick. The substratum is light gray loamy sand about 5 inches thick. Below this is soft sandstone bedrock.

Typically, the Vebar soil has a grayish brown fine sandy loam surface soil about 11 inches thick. The subsoil is about 15 inches thick. It is brown fine sandy loam in the upper part, pale brown sandy loam in the next part, and light gray fine sandy loam in the lower part. The substratum is light gray fine sandy loam about 12 inches thick. Below this is soft sandstone bedrock. In places the surface layer and subsoil are loam.

Included with these soils in mapping are small areas of the deep Parshall soils on foot slopes. These included soils make up about 5 to 15 percent of the unit.

Permeability is rapid in the Beisigl and Flasher soils and moderately rapid in the Vebar soil. Runoff is medium on all three soils. Available water capacity is very low in the Beisigl and Flasher soils and moderate in the Vebar soil. The bedrock underlying all three soils restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. These soils are poorly suited to small grain and flax and to grasses and legumes for hay and pasture. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling erosion and soil blowing. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to

prevent excessive soil loss. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Growing rye or winter wheat helps to control soil blowing in fall, winter, and spring. Also, these crops can make the best use of the early season moisture supply. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on these soils are western wheatgrass, needleandthread, little bluestem, and prairie sandreed. Soil blowing and water erosion are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss.

The Beisigl and Vebar soils are suited to a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Flasher soil generally is unsuited. The Beisigl and Vebar soils are droughty, and the trees and shrubs are commonly affected by moisture stress. Irrigation helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the very low or moderate available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings with basements are constructed on these soils, the depth to bedrock is a limitation, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. Because of the rapid permeability, the Beisigl and Flasher soils do not adequately filter the effluent. The poor filtering capacity may result in the contamination of ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soils tend to be deeper and where the Vebar soil is located, are better sites for waste disposal than the upper parts.

The land capability classification of the Beisigl and Vebar soils is IVe, and that of the Flasher soil is VIe. The range site of the Beisigl soil is Sands, that of the Flasher soil is Shallow, and that of the Vebar soil is Sandy. The productivity index of the unit for spring wheat is 37.

99D—Beisigl-Flasher loamy sands, 9 to 15 percent slopes. These strongly sloping, somewhat excessively drained soils are on uplands. The moderately deep Beisigl soil is on side slopes. The shallow Flasher soil is on ridges. Individual areas range from about 5 to 100 acres in size. They are about 50 to 60 percent Beisigl soil and 20 to 30 percent Flasher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Beisigl soil has a loamy sand surface layer about 9 inches thick. This layer is grayish brown in the upper part and light brownish gray in the lower part. The subsoil is loamy sand about 25 inches thick. It is light brownish gray in the upper part and light gray in the lower part. Below this is soft sandstone bedrock. In some places the surface layer is loamy fine sand. In other places the surface layer and subsoil are sandy loam.

Typically, the Flasher soil has a light brownish gray loamy sand surface layer about 6 inches thick. The substratum is light gray loamy sand about 5 inches thick. Below this is soft sandstone bedrock.

Included with these soils in mapping are small areas of the deep Parshall soils on foot slopes. Also included are a few areas where sandstone crops out. Included areas make up about 5 to 15 percent of the unit.

Permeability is rapid in the Beisigl and Flasher soils. Runoff is medium. Available water capacity is very low. The bedrock restricts the depth to which plant roots can penetrate.

Most areas are used for range. These soils generally are unsuited to cultivated crops but are suited to grasses and legumes for hay and pasture. The hazards of soil blowing and water erosion are severe. The key range plants are prairie sandreed, needleandthread, and little bluestem. Water erosion and soil blowing are problems, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Beisigl soil is suited to a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Flasher soil generally is unsuited. The Beisigl soil is droughty, and the trees and shrubs are commonly affected by moisture stress. Irrigation helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the very low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings with basements are constructed on these soils, the depth to bedrock is a limitation, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. Because of the rapid permeability, the soils do not adequately filter the effluent. The poor filtering capacity may result in the

contamination of ground water. A mound system helps to prevent this contamination.

The land capability classification is VIe. The range site of the Beisigl soil is Sands, and that of the Flasher soil is Shallow. The productivity index of the unit for spring wheat is 0.

109B—Amor loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 50 acres in size.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is loam about 18 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is white silt loam about 10 inches thick. Below this is soft siltstone and sandstone bedrock. In some places the surface layer and subsoil are silt loam or fine sandy loam. In other places the subsoil and substratum contain scoria (porcelainite) fragments.

Included with this soil in mapping are small areas of the deep Shambo soils on foot slopes. These soils make up about 5 to 10 percent of the unit. Also included, in swales, are some areas where the dark color of the surface layer extends to a depth of more than 16 inches.

Permeability is moderate in the Amor soil. Runoff is medium. Available water capacity is moderate. The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, terraces, diversions, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for wildlife. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass, green needlegrass, and needleandthread. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 80.

109C—Amor loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 40 acres in size.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is loam about 18 inches thick. It is brown in the upper part and pale brown in the lower part. The next layer is white silt loam about 10 inches thick. Below this is soft siltstone and sandstone bedrock. In some places the surface layer and subsoil are silt loam. In other places the surface layer is calcareous. In some areas the surface layer and subsoil are sandy loam.

Included with this soil in mapping are small areas of Cabba, Flasher, Regent, and Shambo soils. These soils make up about 5 to 20 percent of the unit. Cabba and Flasher soils are shallow. They are on ridges and knobs. Regent soils have a silty clay loam surface layer and a silty clay subsoil. They are intermingled with areas of the Amor soil. Shambo soils are deep. They are on foot slopes.

Permeability is moderate in the Amor soil. Runoff is medium. Available water capacity is moderate. The bedrock restricts the depth to which plant roots can penetrate. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. This soil is suited to small grain and flax and to grasses and legumes for hay and pasture. The hazard of soil blowing is slight, and the hazard of water erosion is severe. The main concerns in managing cultivated areas are maintaining tilth, overcoming droughtiness, and controlling water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, terraces, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for wildlife.

Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. Leaving tall stubble on the surface helps to trap snow, store soil moisture, and thus overcome the droughtiness.

The key range plants on this soil are western wheatgrass, needleandthread, and green needlegrass. Intermediate and pubescent wheatgrass, smooth bromegrass, and alfalfa are suitable hay and pasture plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil from erosion. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover improve the survival and growth rates of the seedlings.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock generally is soft and can be easily excavated. The effluent in septic tank absorption fields may follow bedding planes in the bedrock and surface downslope or contaminate ground water. A mound system helps to prevent this contamination. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal than the upper parts.

The land capability classification is IIIe. The range site is Silty. The productivity index for spring wheat is 58.

114—Grail-Grassna complex, saline. These deep, level, well drained, moderately saline soils are in swales on uplands. Individual areas range from about 5 to 300 acres in size. They are about 35 to 45 percent Grail soil and 35 to 45 percent Grassna soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Grail soil has a grayish brown surface layer about 8 inches thick. The upper part is silty clay loam, and the lower part is silt loam. The subsoil is about 33 inches thick. It is dark grayish brown silty clay loam in the upper part, grayish brown silty clay in the next part, and light brownish gray silty clay in the lower part. The substratum to a depth of about 60 inches is light brownish gray. It is clay loam in the upper part and sandy clay loam in the lower part.

Typically, the Grassna soil has a grayish brown silt loam surface layer about 9 inches thick. The subsoil is silty clay loam about 13 inches thick. It is grayish brown in the upper part, brown in the next part, and grayish brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is grayish brown in the upper part, light brownish gray in the next part, and pale yellow in the lower part.

Included with these soils in mapping are small areas of Golva, Grassna Variant, and Shambo soils. These included soils make up about 5 to 20 percent of the unit. Golva soils are nonsaline. They are on foot slopes. Grassna Variant soils are strongly saline. They are in depressions. Shambo soils are gravelly loam in the lower part of the substratum and are nonsaline. They are on foot slopes and toe slopes. Also included, on low ridges, are some areas of nonsaline sandy loams.

Permeability is moderately slow in the Grail soil and moderate in the Grassna soil. Runoff is slow on both soils. Available water capacity is moderate. Salts in the soils reduce the amount of water available to plants. A seasonal high water table is at a depth of 4 to 6 feet. Tilth is good.

Most areas are used for cultivated crops. Some are used for range, hay, or pasture. These soils are poorly suited to small grain, flax, and sunflowers and to grasses and legumes for hay and pasture. They are best suited to salt-tolerant crops. Yields are reduced because of the salinity. Crop rotations that include alfalfa and other deep-rooted crops having high moisture requirements help to lower the water table and thus reduce the amount of salt-laden water that moves to the surface. Returning crop residue to the soil or adding other organic material helps to maintain tilth, improves fertility, and increases the rate of water infiltration. A system of conservation tillage that leaves crop residue on the surface reduces the evaporation rate and facilitates the leaching of salts from the surface layer. It also provides food and cover for wildlife.

The key range plants on these soils are western wheatgrass, inland saltgrass, Nuttall alkaligrass, and slender wheatgrass. Tall wheatgrass, alsike clover, alkali sacaton, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the key plants helps to protect the soil from erosion. Stock water ponds constructed in areas of these soils frequently contain salty water.

These soils are suited to only a few of the most salt-tolerant trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs vary in height, density, and vigor, which are affected by the reduced amount of available water resulting from the salts in the soils. Reducing the evaporation rate at the surface improves seedling survival. When the bare soil surface dries, salt-laden water tends to move to the surface.

If buildings are constructed on these soils, the shrink-swell potential and the seasonal high water table are limitations. In this survey area, these soils generally are

not used as sites for buildings or septic tank absorption fields. Better sites generally are nearby.

The land capability classification is IIIs. The range site is Saline Lowland. The productivity index for spring wheat is 48.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

The only map units in the county that meet the soil requirements for prime farmland are Grassna silt loam, 1 to 3 percent slopes, and Grail silty clay loam, 1 to 3 percent slopes. These soils make up less than 7,000 acres, or about 1 percent of the total acreage in the county. Nearly all areas of these soils are used for crops, mainly wheat and sunflowers. The extent of these soils is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops

This section was prepared by Lyle Samson, agronomist, and Dale Ferebee, district conservationist, Soil Conservation Service.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 36 percent of Golden Valley County is cultivated. In 1983, about 90,400 acres was used for close-grown crops, 2,600 acres for row crops, and 41,500 acres for forage crops (*7*). During the period 1978 to 1982, the acreage used for close-grown crops averaged 100,300 acres per year. The acreage of summer fallow was 99,000 acres in 1980 and 90,000 acres in 1983. The acreage used for sunflowers averaged 2,500 per year in the period 1978 to 1982. The acreage used for corn and forage has been stable in recent years. In 1983, the acreages of the principal close-grown crops were as follows: spring wheat, 42,000 acres; durum wheat, 10,000 acres; winter wheat, 8,000 acres; barley, 17,000 acres; oats, 13,000 acres; rye, 200 acres; and flax, 200 acres. The main row crops were sunflowers and corn. Sunflowers were grown on 2,000 acres, corn for grain on 400 acres, and corn for silage on 200 acres. Alfalfa was grown on 17,500 acres and other hay crops on 24,000 acres. Small acreages were planted to sudangrass, sweetclover, potatoes, millet, and safflower.

The potential of the soils in Golden Valley County for increased production of food and fiber is good. This production is steadily increasing as the latest crop production technology is applied. This soil survey can facilitate the application of this technology.

The soils and climate of the county are suited to most of the crops that are commonly grown in the survey area. Crops that are not commonly grown but are suitable include dry edible beans, safflower, and rapeseed.

The principal management measures that help to ensure continuing productivity are those that control soil blowing and water erosion, maintain or improve fertility and tilth, and result in conservation and proper utilization of soil moisture.

Water erosion and soil blowing reduce the productivity of the soils. If the surface layer is lost, most of the available plant nutrients also are lost. As a result,

applications of fertilizer are needed to maintain adequate crop production.

Of equal concern is the loss of organic matter through erosion. Soil structure, water infiltration, available water capacity, and tilth are all negatively affected by this loss. As organic matter is lost and the subsoil is exposed and tilled, the remaining soil becomes increasingly susceptible to both soil blowing and water erosion.

Soil blowing is a hazard on most of the soils in Golden Valley County. It is a severe hazard on the coarse textured and moderately coarse textured soils, including Beisigl, Flasher, Glendive, Hanly, Parshall, and Vebar soils.

Cabba, Cabbart, and Havre soils have a relatively high content of lime and are susceptible to soil blowing in the spring if they have been bare throughout the winter. Because of freezing and thawing, soil structure breaks down, resulting in aggregates that are susceptible to movement. Nearly all soils can be damaged by soil blowing if they are bare.

Water erosion is a severe hazard on moderately sloping to very steep soils, such as the steeper Amor, Cabba, Chama, Cherry, Moreau, and Wayden soils. It also is a severe hazard on Lawther and other soils having slopes that are gentle but long. The hazard is most severe when the surface is bare.

Conservation practices that control both soil blowing and water erosion are those that maintain a protective cover of crops or crop residue. Examples are conservation tillage systems that keep a protective amount of crop residue on the surface. Applications of herbicide can help to eliminate the need for summer fallow tillage. Cover crops also are effective in controlling both soil blowing and water erosion. Field windbreaks, annual wind barriers, and stripcropping (fig. 10) help to control soil blowing. Inclusion of grasses and legumes in the cropping sequence, grassed waterways (fig. 11), diversions, terraces, contour farming, and field stripcropping across the slope help to control water erosion. A management system that includes several measures is the best means of protecting the soil. For example, conservation tillage can control soil blowing during years when the amount of crop residue is adequate, but windbreaks are needed during years when the amount of residue is low.

Stored soil moisture at planting time is critical to the success of the crop during the growing season. In years when the amount of available soil moisture is low at planting time, crop success is greatly reduced. Measures that reduce evaporation and runoff rates, increase the rate of water infiltration, and control weeds conserve moisture. Examples are stubble mulch; mulch tillage; no-till; stripcropping; cover crops; crop residue management; standing stubble, which traps snow; and applications of fertilizer. When fallow is used to carry moisture over to the next season, a cover of crop residue is essential during winter to guard against moisture loss and erosion. Weed control helps to prevent depletion of the moisture supply.

Measures that improve fertility are needed on many soils. Examples are applications of commercial fertilizer, green manure crops, inclusion of legumes in the cropping sequence, and barnyard manure.

Proper management of soils includes measures that maintain good tilth. These measures are especially needed on the soils that have a surface layer of silty clay loam, clay loam, or silty clay. Dimmick, Grail, Lawther, Moreau, and Regent soils are examples. Measures that maintain the content of organic matter are very important if good tilth is to be maintained. The traditional practice of clean-tilled summer fallow contributes to the loss of organic matter because it increases the susceptibility to erosion.

Management of Saline and Alkali Soils

Saline and alkali soils make up about 5 percent of Golden Valley County. Saline soils make up 1 percent of the county, or about 8,000 acres, and alkali soils make up 4 percent, or about 26,000 acres. Saline seeps affect a small acreage in the county.

Saline soils have a high concentration of soluble salts, or salts that dissolve in water. The saline soils in Golden Valley County are phases of the Grail and Grassna series and the Grassna Variant soils. Saline seeps are areas of nonirrigated soils where salinity has recently developed. They are basically low-volume springs. The term "saline seep" distinguishes these recently developed saline soils from residual saline soils of preagricultural origin (*5*). A local term for saline soils is "white alkali."

Saline seeps generally develop in areas of restricted drainage. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is reduced by plants and a surface cover. The plant roots use the soil water before it can reach the surface and before the salts accumulate. The surface cover prevents evaporation at the surface, the upward movement of water in the soil, and the concentration of salts at the surface. Residual saline soils, such as the Grassna Variant soils, generally form in areas adjacent to natural sloughs and waterways. Saline seeps, on the other hand, commonly develop on the upper slopes. Typically, they develop when precipitation moves through the soil and dissolves salts. The salt-laden water that is not used by crops moves downward through the soil until it reaches an impermeable layer that impedes its progress. It then flows laterally until it discharges in areas where the water table is at or near the surface. As a result, salts are concentrated at or near the surface.

Plants growing on saline soils absorb salts from the soil water. Excess amounts of certain salts may interfere with plant growth. High concentrations of some salts are toxic to certain plants. Some salts cause nutritional imbalances or deficiencies by restricting the uptake or availability of certain plant nutrients. Detecting salinity by

Figure 10.—Stripcropping in an area of Chama and Cabba soils. Cabbart soils and rock outcrop are on the butte in the background.

visual observations in the field is difficult. The salts are generally not visible during much of the growing season, particularly when the soil is moist. Flecks, threads, or masses of soluble salts are usually visible when the soil is dry. Laboratory analysis is needed to determine the actual degrees of salinity in soils.

Crop response, particularly during periods of soil moisture stress, is a useful indicator of the degree of salinity in saline soils. For instance, a small grain crop growing on saline soils tends to be stunted and has fewer tillers than small grain on nonsaline soils. Strongly saline soils are best suited to native grasses or to salt-tolerant introduced grasses. Slightly saline or moderately saline soils can produce salt-tolerant crops and forage. Barley is the most salt tolerant of the small grains. Of the forage crops, tall wheatgrass, western wheatgrass, and alfalfa are salt tolerant once they are established.

Saline seeps can be controlled by measures that reduce or prevent the flow of soil water from the contributing area to the seep area. The best measures are growing deep-rooted crops, such as alfalfa and sunflowers, and eliminating or reducing fallow in the contributing area (*5*). The extent of summer fallow can be reduced by a "flex-cropping" system, in which planting decisions are based on the amount of stored soil moisture (*16*). If the amount is adequate at planting time, a crop is planted. Thus, the land is fallowed only in years when the amount of moisture is inadequate at

Figure 11.—A grassed waterway under construction. Grassed waterways help to prevent gullying in areas where runoff concentrates.

planting time. Barriers that trap snow increase the supply of soil moisture at planting time in the spring and thus help to eliminate the need for fallow. Drainage of saline soils generally is not feasible in Golden Valley County because disposal of the salty water is a problem (*16*).

Alkali soils are characterized by a high content of exchangeable sodium, which adheres to the clay particles in the soil. Absher and Belfield are the alkali soils in Golden Valley County. Locally, alkali soils are known as "black-alkali," "slick spots," "pan spots," or "gumbo."

Alkali soils develop in a complex pattern with a very distinct microrelief. The physical and chemical properties of these soils differ markedly within very short distances. In many areas the distance between the alkali soils and the surrounding soils that have normal physical properties is only a few feet, perhaps 5 to 10 feet.

Alkali soils develop in areas of saline soils that contain large quantities of sodium salts. Over a long period, usually centuries, as the water table lowers, rain gradually leaches the salts from the surface to lower horizons. During this leaching process, the clay in the soil becomes saturated with sodium, disperses, and moves downward with the percolating water. As the moving clay concentrates, a dense, alkali subsoil forms. The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air. An example of soils that have a dense, alkali subsoil are the Absher soils.

As the leaching by soil water continues, the sodium is gradually moved lower in the soil profile and eventually is carried below rooting depth. The result is a more manageable soil, such as the Belfield soils. If the leaching process continues and nearly all of the sodium is removed from the profile, the soil eventually changes into a nonalkali soil, such as the Grail soils. This change requires a long period, usually centuries (*6*).

If plowed, alkali soils are characterized by a surface layer that is sticky when wet and hard and cloddy when dry. A crust forms easily at the surface. The chemical and physical properties of these soils are unfavorable for plant growth. The harmful effects of the properties on plants generally increase as the sodium content increases. The effects of the reduced amount of water available to plants are more harmful than the toxic effect of the sodium. The plants also are affected by the depth to the dense subsoil.

Identification of alkali soils in cultivated fields commonly is difficult because many of the physical characteristics, such as columnar structure, have been altered by tillage. Crop response, particularly during periods of soil moisture stress, is a useful indicator of the level of alkalinity in a soil. Crops grown on soils with varying amounts of sodium exhibit varying heights and stages of development. If the level of alkalinity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, the stage of crop growth, and the soil moisture status. A measure of the effect of alkalinity on vegetative growth is not necessarily a reliable measure of crop yields. In many areas the yields of barley and wheat are affected less than the vegetative growth of these crops.

The variability of alkali soils can cause management problems. The alkali soils that have salts within a depth of 16 inches, such as the Absher soils, are generally best suited to native grasses. The soils that have a dense, alkali subsoil near the surface are generally unsuited to small grain and sunflowers.

Timely tillage is an important management need in areas of the leached alkali soils, such as the Belfield soils. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soils puddle and crust. If the soils are tilled when too dry, tillage and seeding implements cannot easily penetrate the surface. Deep plowing and chemical amendments can help to reclaim alkali soils, but they may not be feasible. To be effective, deep tillage should reach to the alkali subsoil and mix several inches of the underlying material with the subsoil and topsoil. Depending on the soil, tillage to a depth of 15 to 36 inches may be needed. Any reclamation of alkali soils is a long-term endeavor. Complete reclamation may never be achieved. Onsite investigation is needed to confirm the feasibility of deep tillage in a particular area.

Additional information about management or reclamation of saline and alkali soils is available from the Soil Conservation Service, the North Dakota Agricultural Experiment Station, and the Cooperative Extension Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Productivity Index

The productivity index is a relative rating of the ability of a particular map unit to produce a particular crop yield in comparison to other map units. The index ranges from 0, which indicates no yield, to 100, which indicates the highest yield. When the index is calculated, the similar and contrasting inclusions are considered as well as the soils specified in the name of the map unit. In Golden Valley County a productivity index of 100 was considered equal to an average yield of 31 bushels per acre of spring wheat. Multiplying the productivity index by 31 and then dividing the product by 100 will convert the index number to a figure representing the expected average yield per acre. Shambo loam, 1 to 3 percent slopes, for example, has a productivity index of 83, which when multiplied by 31 and then divided by 100, converts to 26, which is the expected annual yield of spring wheat in bushels per acre for this map unit. (See table 5.) The productivity index for each map unit is given in the section "Detailed Soil Map Units."

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and

limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

This section was prepared by Brian Gerbig, range conservationist, Soil Conservation Service.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

The native vegetation on rangeland consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. Generally, the plants are suitable for grazing and the plant cover is sufficiently productive to justify grazing. Cultural treatments generally are not used to increase forage production. The composition and production of the plant community are determined by soil, climate, topography, overstory canopy, and grazing management.

In 1983, approximately 371,000 acres in Golden Valley County, or about 57 percent of the total acreage, was rangeland. Of this acreage, about 96,000 acres is owned and managed by the U.S. Department of Agriculture, Forest Service. In areas where it is properly managed, the rangeland is similar to the presettlement prairie of the late 1800's and early 1900's. Most of the rangeland is on loamy uplands and terraces. Much of it occurs as nearly level to rolling soils that have an alkali subsoil and steep soils that are shallow or moderately deep over bedrock. The soils are generally unsuited or poorly suited to cultivated crops.

Most of the ranches include a cow-calf operation. A number also include a yearling operation, which adds flexibility during periods of low or high forage production. On some ranches used for a cow-calf operation, sheep are raised for improved income stability. In 1984, the farms and ranches in the county had about 31,000 head of cattle (*7*).

Because of the relatively short growing season, many farmers and ranchers have established cool-season tame pastures to supplement the forage produced on rangeland and to extend the grazing season in the spring and fall. Droughts of short duration are common. As a result, cool-season pastures cannot be grazed in the fall in many years. Generally, large amounts of hay and feed are needed because of the long winters. Hay was harvested on about 29,000 acres in 1984 (*7*).

Range Site and Condition Classes

Soils vary in their capacity to produce grasses and other plants suitable for grazing. Soils that produce about the same kinds and amounts of forage are grouped into a range site.

Each range site has a distinctive potential plant community that is referred to as the climax vegetation. The climax vegetation is relatively stable and indicates what the range site is capable of producing. It reproduces itself annually and changes very little as long as the environment remains unchanged. On the prairie the climax vegetation consists of the kinds of plants that grew when the region was settled. It is generally the most productive combination of forage plants that can be grown on the site. When the site is grazed, some of the climax vegetation decreases in extent and some of it increases. Also, other plants invade the site.

Decreaser plants are the species that decline in quantity under continuous close grazing. They generally are the tallest and most productive grasses and forbs and are the most palatable to livestock.

Increaser plants are the species that increase in quantity under close grazing at the expense of the decreaser species. They generally are the shorter plants or the ones less palatable to livestock.

Invader plants are species normally not included in the climax plant community because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site only after the extent of the climax vegetation has been reduced by continual heavy grazing. Most invader species have little grazing value.

Range condition classes indicate the present composition of the plant community on a range site in relation to the climax vegetation. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the climax. *Excellent* indicates that 76 to 100 percent of the present plant community is the same as the climax vegetation; *good*, 51 to 75 percent; *fair*, 26 to 50 percent; and *poor*, 25 percent or less.

Potential forage production depends on the kind of range site. Current forage production depends on the range condition and the moisture available to the plants during the growing season.

Table 6 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Good range management keeps the range in excellent or good condition. Water is conserved, yields are improved, and the soils are protected. The main management concern is recognizing the changes in the plant community that take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall, for example, may lead to the conclusion that the range is in good condition, when actually the plant cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been grazed closely for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover rapidly.

Rangeland has the ability to recover from prolonged overuse if the climax decreaser species have not been completely grazed out. If overgrazing is stopped, enough climax plants generally remain for proper grazing use, deferred grazing, and the grazing system to restore the rangeland to an excellent condition. In areas where the climax plant community has been destroyed, range seeding can improve the condition. Seeding the proper climax species also can restore productive rangeland in areas of poor-quality cropland. Brush control, development of watering facilities (fig. 12), and other mechanical practices are needed to improve the potential of some rangeland. Fencing is one of the most overlooked means of improving rangeland.

The following paragraphs describe the range sites in Golden Valley County. The names of these sites are Clayey, Overflow, Saline Lowland, Sands, Sandy, Shallow, Shallow Clay, Silty, Thin Claypan, Thin Sands, Very Shallow, and Wetland.

Figure 12.—A water impoundment in an area of range. Water impoundments help to achieve a uniform distribution of grazing.

Clayey range site. This site is dominated by a mixture of cool-season, mid grasses and an understory of short grasses. The principal species are western wheatgrass, needleandthread, green needlegrass, and prairie junegrass. The understory plants are blue grama, inland saltgrass, buffalograss, Pennsylvania sedge, and other upland sedges. Forbs, such as western yarrow, scarlet globemallow, prairie coneflower, and prairie thermopsis, make up about 5 percent of the total herbage. The common woody plants are fringed sagebrush, western snowberry, and prairie rose.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, needleandthread, green needlegrass, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, low-quality forbs, and fringed sagewort.

Very few problems affect management of this site. The water infiltration rate is slow. As a result, an adequate cover of vegetation is needed to help ensure that forage production is not reduced by runoff. Areas where the range is in poor or fair condition can generally be restored to good or excellent condition by good management of the remnant climax species.

Overflow range site. Both tall and mid grasses are dominant when this site is in excellent condition. The principal species are big bluestem, green needlegrass, western wheatgrass, and needleandthread. Other species are porcupinegrass, bearded wheatgrass, thickspike wheatgrass, Pennsylvania sedge, fescue sedge, little bluestem, and Kentucky bluegrass. Several forbs, such as Missouri goldenrod and tall white aster, make up about 10 percent of the total herbage. Several woody plants, such as western snowberry, prairie rose, common chokecherry, buffaloberry, and green ash, commonly grow on the site, depending on the position on the landscape. They may make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, green needlegrass, prairie dropseed, and little bluestem. The

plants that increase in abundance under these conditions are western wheatgrass, blue grama, Pennsylvania sedge, fescue sedge, and Kentucky bluegrass. Further deterioration results in a dominance of blue grama, sedges, and unpalatable forbs.

Because of its position on the landscape, this site is frequently overgrazed. Fencing generally is not feasible because of the small size or the shape of areas of this site. As a result of flooding and the runoff received by these areas, this is a very productive site when properly managed. A planned grazing system can restore the site and maintain a high level of productivity. Reseeding is needed in areas that have been farmed. In areas where shrubs dominate, brush control can help to restore productivity.

Saline Lowland range site. Salt-tolerant, mid grasses dominate this site. The principal species are Nuttall alkaligrass, inland saltgrass, alkali cordgrass, and salt-tolerant varieties of western wheatgrass and slender wheatgrass. Other species are alkali muhly, foxtail barley, mat muhly, and prairie bulrush. Forbs, such as silverweed cinquefoil and Pursh seepweed, make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as Nuttall alkaligrass, slender wheatgrass, and alkali cordgrass. The plants that increase in abundance under these conditions are western wheatgrass, inland saltgrass, foxtail barley, and mat muhly. Further deterioration results in a dominance of inland saltgrass, foxtail barley, mat muhly, and unpalatable forbs, such as silverweed cinquefoil and dock.

A high content of salts and a restricted available water capacity limit forage production on this site. Careful management of the adapted salt-tolerant plants can maintain good forage production. If the plant community has been severely damaged, however, the site recovers slowly. Soil blowing and water erosion are hazards in denuded areas. Stock water ponds on this site frequently contain salty water. If feasible, alternative water sources should be developed.

Sands range site. The principal grasses on this site are prairie sandreed, needleandthread, sand bluestem, and little bluestem. Other species are blue grama, prairie junegrass, sand dropseed, western wheatgrass, and upland sedges. Forbs make up about 10 percent of the total herbage. This site has a small amount of woody species, such as prairie rose, western snowberry, and leadplant amorpha.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie sandreed, needleandthread, little bluestem, sand bluestem, and leadplant amorpha. The plants that increase in abundance under these conditions are sand dropseed, blue grama, upland sedges, and several forbs. Further deterioration results in a dominance of blue grama, Pennsylvania sedge, threadleaf sedge, sun sedge, and unpalatable forbs, such as green sagewort, fringed sagewort, and gray sagewort.

A low or very low available water capacity and the hazard of soil blowing are concerns in managing this site. Measures that minimize the formation of livestock trails and that do not allow the animals to concentrate in an area for too long a time are needed. In severely overgrazed areas, blowouts are common. On large blowouts, shaping, seeding, and mulching are needed before the climax vegetation can be reestablished. The vegetation in areas where the site is in fair or poor condition responds rapidly to improved grazing management.

Sandy range site. The principal grasses on this site are needleandthread and prairie sandreed. Other species are prairie junegrass, blue grama, western wheatgrass, green needlegrass, and upland sedges. The site generally has a number of early season forbs, such as western yarrow and silverleaf scurfpea. Woody plants, such as western snowberry and leadplant amorpha, make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as needleandthread, green needlegrass, prairie sandreed, and leadplant amorpha. The plants that increase in abundance under these conditions are blue grama, upland sedges, sand dropseed, and several forbs. Further deterioration results in a dominance of blue grama, Pennsylvania sedge, threadleaf sedge, sun sedge, and unpalatable forbs, such as western yarrow, green sagewort, and gray sagewort.

A low or moderate available water capacity is a concern in managing this site. Also, soil blowing is a hazard in denuded areas. Management that maintains the abundance of the key species results in a natural plant community that provides excellent forage for livestock and a protective plant cover.

Shallow range site. A mixture of cool- and warm-season, mid grasses dominates this site. The principal species are western wheatgrass, needleandthread, little bluestem, and prairie sandreed. Other species are plains muhly, blue grama, sideoats grama, threadleaf sedge, and Pennsylvania sedge. The percentage of wheatgrass is generally somewhat higher on the medium textured soils, and the percentage of prairie sandreed is generally higher on the coarse textured soils. Forbs make up about 10 percent of the total herbage. The site has only a small amount of woody plants.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as little bluestem, needleandthread, sideoats grama, and prairie sandreed. The plants that increase in abundance under these conditions are blue grama, western wheatgrass, red

threeawn, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, unpalatable forbs, and fringed sagewort.

Because of a limited available water capacity, forage production is limited on this site. It varies, depending on rainfall patterns. The site is fragile, and the plant community can deteriorate rapidly if poor management results in severe erosion. Management that keeps the plant community near its potential helps to control erosion and results in the best use of the available water.

Shallow Clay range site. The principal grasses on this site are western wheatgrass, green needlegrass, blue grama, plains muhly, and Sandberg bluegrass. These and other grasses make up about 80 percent of the total herbage. Forbs, such as prairie thermopsis, povertyweed, wooly indianwheat, and rush skeletonplant, make up about 10 percent. Shrubs and half-shrubs, such as fringed sagebrush, broom snakeweed, big sagebrush, and Nuttall saltbush, make up the rest.

Heavy grazing by cattle results in a decrease in the abundance of western wheatgrass, green needlegrass, plains muhly, and prairie junegrass. Under these conditions, blue grama, Sandberg bluegrass, inland saltgrasses, needleleaf sedge, and other upland sedges initially respond as increasers. Further deterioration results in a dominance of blue grama, fringed sagebrush, upland sedges, and unpalatable forbs.

This site is fragile because the soils are shallow and have a limited available water capacity. Good grazing management helps to maintain a protective plant cover. Gullies can form along cattle trails and in denuded areas. A planned grazing system is an excellent means of restoring productivity when the site is in poor or fair condition.

Silty range site. Mid grasses dominate this site. The principal species are western wheatgrass, needleandthread, green needlegrass, and prairie junegrass. Other species are blue grama, Pennsylvania sedge, threadleaf sedge, needleleaf sedge, and red threeawn. Forbs make up about 10 percent of the total herbage. The site has minor amounts of weedy species.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and porcupinegrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, Pennsylvania sedge, threadleaf sedge, needleleaf sedge, and red threeawn. Further deterioration results in a dominance of blue grama, threadleaf sedge, needleleaf sedge, and varying amounts of fringed sage, green sagewort, gray sagewort, and other forbs.

Generally, no major problems affect management of this site. In the sloping areas, however, gullies can form along livestock trails. Fencing and improved grazing management help to prevent gullying. They are also beneficial in areas where gullies have already formed. Areas where the site is in poor or fair condition generally can be restored to good or excellent condition by good management. In some areas brush control is needed.

Thin Claypan range site. Short grasses dominate this site. The principal species are western wheatgrass, blue grama, prairie junegrass, and Sandberg bluegrass. Other species are inland saltgrass, tumblegrass, buffalograss, Pennsylvania sedge, and other upland sedges. Forbs make up about 5 percent of the total herbage. The common woody plants are fringed sagebrush, broom snakeweed, and cactus.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, prairie junegrass, and needleandthread. Plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, upland sedges, and fringed sagebrush. Further deterioration results in a dominance of short grasses, sedges, fringed sagebrush, broom snakeweed, and undesirable forbs.

Because of a high content of salts near the surface, productivity is quite low on this site. The site produces good-quality forage for cattle only if properly managed. If the site is in poor or fair condition, recovery is quite slow because of the salts and a dense, alkali subsoil. Careful management can restore the site to good or excellent condition. If the vegetation has been destroyed by cultivation or the site denuded, range seeding can restore the climax vegetation. Good seeding techniques are needed. Stock water pits should not be constructed on this site because the water is likely to be salty.

Thin Sands range site. Mid grasses dominate this site. The principal species are prairie sandreed, needleandthread, and sand dropseed. Other species are blue grama, hairy grama, Pennsylvania sedge, threadleaf sedge, and sand bluestem. Forbs make up about 10 percent of the total herbage. The site has minor amounts of woody plants.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie sandreed, needleandthread, and sand bluestem. The plants that increase in abundance under these conditions are Pennsylvania sedge, threadleaf sedge, blue grama, and hairy grama. Further deterioration results in a dominance of dryland sedges, blue grama, and several unpalatable forbs.

This site is very fragile and is subject to soil blowing if the vegetation is damaged by overgrazing or the soil is denuded. Blowouts are common in overgrazed areas. Good management can keep the site in good or excellent condition. In areas where the site is in poor or fair condition, careful management can restore productivity. A planned grazing system that includes

adequate rest periods between the grazing periods is needed.

Very Shallow range site. The site has a mixture of cool- and warm-season, mid grasses. Forage production is much lower than that on the Shallow range site. The principal species are needleandthread, western wheatgrass, little bluestem, blue grama, and plains muhly. Other species are prairie junegrass, red threeawn, sideoats grama, and upland sedges. Forbs and woody plants make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as needleandthread, western wheatgrass, little bluestem, sideoats grama, and plains muhly. The plants that increase in abundance under these conditions are blue grama, red threeawn, sand dropseed, Sandberg bluegrass, and upland sedges. Further deterioration results in a dominance of blue grama, red threeawn, upland sedges, and undesirable forbs and shrubs.

Available water capacity is very low on this site. Also, water erosion is a hazard in the sloping areas. Gullies can readily form along cattle trails and in denuded areas. The site is frequently overgrazed. Once it is in fair or poor condition, it recovers slowly because of the very low available water capacity. Productivity can be maintained by careful management of the cool-season, mid grasses and by cross fencing, which helps to control livestock traffic patterns.

Wetland range site. About 50 percent of the natural plant community on this site is grasses, and 45 percent is grasslike plants. The principal species are rivergrass and slough sedge. Other species are prairie cordgrass, northern reedgrass, American mannagrass, American sloughgrass, slim sedge, common spikesedge, and Baltic rush. Forbs, such a longroot smartweed, curled dock, Rydberg sunflower, false aster, and tall white aster, make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of rivergrass and slough sedge. The species that increase in abundance under these conditions are slim sedge, Baltic rush, common spikesedge, and American sloughgrass. Further deterioration results in a plant community dominated by Baltic rush, common spikesedge, false aster, and curled dock.

This site is suited to hay and grazing. If possible, grazing should be limited to summer and fall. Grazing during wet periods can result in compaction and root shearing. If the plant community has deteriorated, deferment of grazing during the growing season or a planned grazing system can restore productivity. Seeding reed canarygrass and creeping foxtail also helps to restore productivity. Improved management can be better applied in areas where fences separate this site from other range sites.

Woodland, Windbreaks, and Environmental Plantings

This section was prepared by Bruce C. Wight, forester, Soil Conservation Service.

Golden Valley County has about 2,400 acres of native woodland (*10*). Most of the woodland is in the Badlands, in upland draws, and on flood plains.

The species of trees and shrubs in the Badlands are closely related to aspect. The southern aspect has an even distribution of Rocky Mountain juniper and creeping juniper. The northern and southeastern aspects also support Rocky Mountain juniper, but green ash grows in swales, depressions, and other areas where moisture accumulates. Shrubs, such as common chokecherry, Woods rose, and currant, also grow on these aspects. Brandenburg, Cabbart, and Cherry are the principal soils in the Badlands.

Aspect also is important in the upland draws. Trees generally grow only on the northern and northeastern aspects, where snow accumulates and where the direct rays of the sun are limited. The dominant species is green ash. Other important species are Rocky Mountain juniper, common chokecherry, Woods rose, and currant.

On the flood plains, the dominant species vary, depending on the distance from the headwaters. In the areas more distant from the headwaters, such as those along the Little Missouri River, the dominant species is eastern cottonwood. In areas closer to the headwaters, such as those along Bull Run and Beaver Creek, the dominant species are green ash and American elm. The understory species include boxelder, willow, common chokecherry, American elm, currant, silver buffaloberry, and Woods rose. Glendive, Hanly, Havre, and Korchea are the principal soils on the flood plains.

The early settlers used the trees and shrubs for fuel, lumber, and fenceposts. Currently, there is a renewed interest in using trees for fuel. The principal uses of the trees, however, are for protection and esthetic purposes. Windbreaks have been planted in Golden Valley County since the early days of settlement. Most of the early plantings were made to protect farmsteads and livestock.

Since the 1930's, approximately 1 million trees have been planted on about 1,600 acres by county farmers and ranchers assisted by the Golden Valley Soil Conservation District and the Soil Conservation Service. Trees and shrubs are still needed around many farmsteads. They are also needed to replace existing plantings that are maturing. Field windbreaks are needed in areas where the soils are highly susceptible to soil blowing.

Before windbreaks are established, the purpose of the windbreak, the suitability of the soils for the various species of trees and shrubs selected for planting, and the location and design of the windbreak should be

considered. Otherwise, a poor or unsuccessful windbreak may result. Proper site preparation and adequate maintenance are needed after the trees and shrubs are planted. Competing grasses and weeds should be eliminated before the trees and shrubs are planted, and the regrowth of this ground cover should be controlled for the life of the windbreak. Some replanting of the trees and shrubs may be necessary during the first 2 years.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

This section was prepared by Erling B. Podoll and David D. Dewald, biologists, Soil Conservation Service.

Golden Valley County has a number of recreational facilities, which are provided by city, county, state, federal, and private entities. The facilities are used for outdoor activities, such as fishing, boating, swimming, camping, picnicking, golfing, softball, trapshooting, and ice skating. Opportunities for outdoor activities requiring few or no basic facilities are available in the county, especially on public lands. These activities include birding, hiking, hunting, and cross-country skiing.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

This section was prepared by Erling B. Podoll and David D. Dewald, biologists, Soil Conservation Service.

Fish and wildlife resources are an important part of the social and economic life in Golden Valley County. Wildlife populations currently are lower than they were before the county was settled. Habitat quality and diversity are good, but the extent of the habitat has been reduced by cultivation and yearlong grazing. The increased use of conservation tillage, especially no-till, is having a positive impact on the extent and quality of the habitat.

The county has a wide variety of game and nongame wildlife. Bird species that are hunted are sharp-tailed grouse, ring-necked pheasant, gray partridge, ducks, sage grouse, and mourning dove. Mammals that generally are either hunted or trapped include white-tailed deer, mule deer, pronghorn antelope, cottontail rabbit, red fox, coyote, raccoon, beaver, mink, badger, white-tailed jackrabbit, and striped skunk.

Private landowners in Golden Valley County manage about 32,000 acres primarily for wildlife. Most of this habitat is for upland wildlife.

The county has three fishing reservoirs. These are Camel Hump, Odland, and Williams Lakes. The latter two are marginal fisheries. The potential for the development of new fishing waters or for improving existing waters is good.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, sunflowers, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are wheatgrasses, lovegrass, bromegrass, sweetclover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are stiff sunflower, goldenrod, wheatgrass, needlegrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are common chokecherry, buffaloberry, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include gray partridge, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sharp-tailed grouse, sage grouse, meadowlark, and lark bunting.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading

is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly

erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16. An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high

the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the North Dakota State Highway Department Laboratory.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*15*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that has a frigid temperature regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed Typic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*14*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*15*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Absher Series

The Absher series consists of deep, moderately well drained, very slowly permeable, alkali soils on uplands. These soils formed in loamy, clayey, and silty alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Absher loam, 1 to 6 percent slopes, 15 feet south and 760 feet east of the northwest corner of sec. 25, T. 136 N., R. 106 W.

E—0 to 2 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak very thin platy structure; loose, very friable, slightly sticky and slightly plastic; many very fine roots; mildly alkaline; clear wavy boundary.

Bt—2 to 6 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; strong coarse columnar structure parting to strong medium angular blocky; hard, firm, very sticky and very plastic; common very fine roots; few very fine pores; many distinct clay films on faces of peds; few uncoated sand grains on faces of peds; moderately alkaline; gradual wavy boundary.

Btyz—6 to 19 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong coarse prismatic structure parting to strong medium angular blocky; hard, firm, very sticky and very plastic; few very fine roots; few very fine pores; many distinct clay films on faces of peds; few fine salt crystals; few fine masses of gypsum crystals; slight effervescence; moderately alkaline; gradual wavy boundary.

Bkyz—19 to 27 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; strong coarse prismatic structure parting to strong medium angular blocky; hard, firm, sticky and plastic; few very fine roots; common very fine pores; few fine salt crystals; few fine masses of gypsum crystals; lime disseminated throughout and in fine soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk1—27 to 39 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; strong coarse angular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine pores; lime disseminated throughout and in common fine threads and soft masses; violent effervescence; strongly alkaline; gradual wavy boundary.

Bk2—39 to 58 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; strong coarse angular blocky structure; hard, firm, sticky and plastic; many very fine pores; lime disseminated throughout and in common fine threads and soft masses; violent effervescence; strongly alkaline; gradual wavy boundary.

C—58 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and plastic; many very fine pores; few fine salt crystals; few fine masses of gypsum crystals; lime disseminated throughout and in few fine threads and common fine soft masses; strong effervescence; strongly alkaline.

The E horizon has value of 6 or 7 (3 or 4 moist) and chroma of 2 or 3. The Btyz, Bk, and C horizons are silty clay, clay, silty clay loam, or clay loam. The Btyz and Bk horizons have hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. The C horizon has hue of 10YR to 5Y, value of 5 to 7 (3 to 5 moist), and chroma of 2 to 4.

Amor Series

The Amor series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft siltstone, sandstone, or shale bedrock. Slope ranges from 3 to 9 percent.

Typical pedon of Amor loam, 3 to 6 percent slopes, 1,700 feet south and 1,000 feet east of the northwest corner of sec. 26, T. 138 N., R. 105 W.

Ap—0 to 6 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; neutral; abrupt smooth boundary.

Bw1—6 to 15 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; mildly alkaline; clear wavy boundary.

Bw2—15 to 24 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; mildly alkaline; gradual wavy boundary.

BCk—24 to 34 inches; white (2.5Y 8/2) silt loam, light olive brown (2.5Y 5/4) moist; massive; hard, very friable, slightly sticky and plastic; few very fine roots; many very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—34 to 60 inches; white (2.5Y 8/2) and light gray (5Y 7/2) soft siltstone and sandstone bedrock, light brownish gray (2.5Y 6/2) and pale yellow (5Y 7/3) moist; violent effervescence; moderately alkaline.

The depth to soft bedrock ranges from 20 to 40 inches. The A horizon has value of 4 or 5 and chroma of 2 or 3 (dry or moist). The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3 (dry or moist). The BCk horizon has hue of 10YR or 2.5Y, value of 6 to 8 (4 to 6 moist), and chroma of 2 to 4 (dry or moist). The Cr horizon is soft, fine grained sandstone, siltstone, or shale.

Baahish Series

The Baahish series consists of deep, somewhat excessively drained soils on terraces and outwash plains. These soils formed in loamy outwash sediments. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 6 to 25 percent.

Typical pedon of Baahish loam, in an area of Baahish-Cabbart loams, 6 to 25 percent slopes, 1,300 feet north

and 1,300 feet west of the southeast corner of sec. 5, T. 137 N., R. 104 W.

A—0 to 5 inches; dark brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine pores; about 3 percent gravel; neutral; clear smooth boundary.

Bw—5 to 8 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine pores; about 10 percent gravel; lime disseminated throughout; violent effervescence; mildly alkaline; gradual wavy boundary.

2C1—8 to 16 inches; pale brown (10YR 6/3) very gravelly loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; about 35 percent gravel; lime disseminated throughout; violent effervescence; mildly alkaline; gradual wavy boundary.

2C2—16 to 24 inches; light yellowish brown (10YR 6/4) very gravelly loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; about 60 percent gravel; lime disseminated throughout; violent effervescence; mildly alkaline; gradual wavy boundary.

2C3—24 to 36 inches; light yellowish brown (10YR 6/4) very gravelly loam, olive brown (2.5Y 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; about 55 percent gravel; lime disseminated throughout; violent effervescence; mildly alkaline; gradual wavy boundary.

2C4—36 to 60 inches; pale brown (10YR 6/3) very gravelly loam, olive brown (2.5Y 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; about 50 percent gravel; lime disseminated throughout; violent effervescence; moderately alkaline.

The depth to a layer in which the content of gravel is 35 percent or more ranges from 7 to 16 inches. The A horizon has value of 4 or 5 (2 or 3 moist).

Beisigl Series

The Beisigl series consists of moderately deep, somewhat excessively drained, rapidly permeable soils on uplands. These soils formed in material weathered from soft sandstone bedrock. Slope ranges from 3 to 15 percent.

Typical pedon of Beisigl loamy sand, in an area of Beisigl-Flasher-Vebar complex, 3 to 9 percent slopes, 900 feet south and 600 feet west of the northeast corner of sec. 22, T. 141 N., R. 104 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; few very fine pores; slight effervescence; moderately alkaline; clear smooth boundary.

A—6 to 9 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, loose, nonsticky and nonplastic; few very fine roots; common very fine pores; few fine soft masses of lime; slight effervescence; moderately alkaline; gradual irregular boundary.

Bk1—9 to 16 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grain; soft, loose, nonsticky and nonplastic; few very fine roots; many very fine pores; few fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk2—16 to 34 inches; light gray (10YR 7/2) loamy sand, brown (10YR 5/3) moist; single grain; soft, loose, nonsticky and nonplastic; few very fine roots; common very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—34 to 60 inches; light brownish gray (2.5Y 6/2) soft sandstone, grayish brown (2.5Y 5/2) moist; strong effervescence; moderately alkaline.

The depth to soft bedrock ranges from 20 to 40 inches. The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6 (moist), and chroma of 2 to 4. It is loamy sand, fine sand, or loamy fine sand.

Belfield Series

The Belfield series consists of deep, well drained, slowly permeable, alkali soils on uplands. These soils formed in material weathered from soft siltstone and shale bedrock or in clayey, loamy, and silty alluvium. Slope ranges from 1 to 6 percent.

These soils have less clay and sodium than is definitive for the Belfield series. These differences, however, do not alter the usefulness or behavior of the soils.

Typical pedon of Belfield loam, 1 to 6 percent slopes, 2,700 feet south and 135 feet east of the northwest corner of sec. 3, T. 136 N., R. 106 W.

A1—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; slightly acid; clear smooth boundary.

A2—7 to 11 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong coarse prismatic structure parting to strong fine and medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; many very fine pores; slightly acid; clear wavy boundary.

B/E—11 to 21 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist (B); grayish brown (10YR 5/2) silt coatings (E); strong coarse prismatic structure parting to strong fine and medium angular blocky; hard, very firm, very sticky and very plastic; common very fine roots; many very fine pores; uncoated sand grains on faces of peds in the upper 2 inches; neutral; gradual wavy boundary.

Bt—21 to 31 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; strong coarse prismatic structure parting to strong fine and medium subangular blocky; hard, very firm, very sticky and very plastic; few very fine roots; many very fine pores; many distinct clay films on faces of peds; neutral; gradual wavy boundary.

Bk—31 to 43 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, very firm, very sticky and very plastic; few very fine roots; many very fine pores; lime disseminated throughout and in common fine masses; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkyz—43 to 50 inches; light gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, very firm, very sticky and very plastic; few very fine roots; many very fine pores; common masses and filaments of salt crystals; common threads and masses of gypsum crystals; few soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Cyz—50 to 60 inches; light gray (2.5Y 7/2) fine sandy loam, light brownish gray (2.5Y 6/2) moist; massive; hard, friable, sticky and plastic; few very fine roots; common very fine pores; few masses and filaments of salt crystals; few threads and masses of gypsum crystals; slight effervescence; moderately alkaline.

The depth to carbonates ranges from 15 to 35 inches. The thickness of the mollic epipedon ranges from 9 to 22 inches.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 7 (2 to 5 moist), and chroma of 2 or 3. It is clay loam, silty clay loam, or silty clay. The C horizon has value of 5 to 7 (3 to 6 moist) and chroma of 2 to 4. It is loam or fine sandy loam.

Brandenburg Series

The Brandenburg series consists of deep, excessively drained soils on uplands. These soils formed in loamy material weathered from porcelainite. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 6 to 50 percent.

Typical pedon of Brandenburg channery loam, in an area of Brandenburg-Cabbart complex, 6 to 50 percent slopes, 700 feet north and 1,000 feet west of the southeast corner of sec. 29, T. 141 N., R. 104 W.

A—0 to 6 inches; light brown (7.5YR 6/4) channery loam, dark brown (7.5YR 4/4) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; about 20 percent porcelainite channers; mildly alkaline; clear smooth boundary.

C1—6 to 14 inches; light red (2.5YR 6/6) and pink (7.5YR 7/4) very channery loam, red (2.5YR 4/6) and dark brown (7.5YR 4/4) moist; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; about 50 percent porcelainite channers; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—14 to 60 inches; light red (2.5YR 6/8) fractured porcelainite coated with lime; fine earth is present but does not fill interstices; strong effervescence.

The depth to fractured porcelainite ranges from 10 to 20 inches. The A horizon has hue of 2.5YR to 7.5YR, value of 5 or 6 (3 or 4 moist), and chroma of 2 to 4. The C horizon has hue of 2.5YR to 7.5YR, value of 6 to 8, and chroma of 4 to 8.

Cabba Series

The Cabba series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft siltstone and sandstone bedrock. Slope ranges from 3 to 15 percent.

Typical pedon of Cabba silt loam, in an area of Cabba-Chama silt loams, 3 to 9 percent slopes, 430 feet south and 350 feet west of the northeast corner of sec. 8, T. 141 N., R. 105 W.

Ap—0 to 6 inches; light brownish gray (10YR 6/2) silt loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; few fine and very fine roots; few very fine pores; lime disseminated throughout; strong effervescence; moderately alkaline; abrupt smooth boundary.

C—6 to 15 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; weak very thin platy structure; hard, very friable, slightly sticky and plastic; few very fine roots; few very fine pores; lime

disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—15 to 60 inches; light gray (2.5Y 7/2) and light yellowish brown (2.5Y 6/4) stratified soft siltstone bedrock, light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4) moist; violent effervescence in the upper 6 inches; strongly alkaline.

The depth to soft bedrock ranges from 10 to 20 inches. The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 (3 or 4 moist), and chroma of 2 or 3 (dry or moist). The C horizon has hue of 10YR to 5Y, value of 5 to 8 (4 to 7 moist), and chroma of 2 or 3. It is loam or silt loam. The Cr horizon is siltstone or sandstone.

Cabbart Series

The Cabbart series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft siltstone bedrock. Slope ranges from 6 to 50 percent.

Typical pedon of Cabbart silt loam, in an area of Cabbart-Badland complex, 15 to 50 percent slopes, 2,200 feet north and 450 feet west of the southeast corner of sec. 25, T. 137 N., R. 103 W.

A—0 to 4 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; few very fine pores; soft masses of lime; strong effervescence; mildly alkaline; gradual wavy boundary.

Bk—4 to 14 inches; white (2.5Y 8/2) silt loam, light yellowish brown (2.5Y 6/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; many fine filaments of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—14 to 60 inches; pale yellow (5Y 7/3) soft siltstone bedrock, pale olive (5Y 6/3) moist; common large yellowish brown (10YR 5/6) mottles; strong effervescence; moderately alkaline.

The depth to soft bedrock ranges from 10 to 20 inches. The A and Bk horizons are loam or silt loam. The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 (3 to 5 moist), and chroma of 2 or 3 (dry or moist). The Bk horizon has hue of 10YR or 2.5Y, value of 6 to 8 (4 to 6 moist), and chroma of 2 to 4 (dry or moist).

Chama Series

The Chama series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft siltstone bedrock. Slope ranges from 1 to 15 percent.

Typical pedon of Chama silt loam, 3 to 6 percent slopes, 225 feet south and 620 feet east of the northwest corner of sec. 5, T. 137 N., R. 104 W.

Ap—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; slightly hard, very friable, sticky and plastic; common very fine roots; many very fine pores; violent effervescence; moderately alkaline; abrupt smooth boundary.

Bw—4 to 7 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak very fine and fine subangular blocky structure; slightly hard, very friable, sticky and plastic; common very fine roots; many very fine pores; common fine soft masses of lime; strong effervescence; moderately alkaline; clear wavy boundary.

Bk—7 to 15 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak very fine subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine roots; many very fine pores; many fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

BCk—15 to 25 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) moist; massive; slightly hard, very friable, sticky and plastic; few very fine roots; common very fine pores; lime disseminated throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—25 to 60 inches; light brownish gray (2.5Y 6/2) and light olive gray (5Y 6/2) soft siltstone bedrock; strong effervescence; mildly alkaline.

The mollic epipedon is 7 to 10 inches thick. The depth to soft bedrock ranges from 20 to 40 inches.

The A horizon has value of 3 to 5 (2 or 3 moist). The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3 (dry or moist).

Cherry Series

The Cherry series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in silty and loamy alluvium. Slope ranges from 3 to 15 percent.

Typical pedon of Cherry silt loam, in an area of Cabbart-Cherry silt loams, 9 to 35 percent slopes, 1,050 feet south and 2,050 feet east of the northwest corner of sec. 3, T. 142 N., R. 105 W.

A—0 to 4 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine pores; lime disseminated

throughout; strong effervescence; mildly alkaline; clear wavy boundary.

Bw1—4 to 9 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bw2—9 to 26 inches; light gray (2.5Y 7/2) silty clay loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; few fine filaments and masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—26 to 50 inches; pale yellow (2.5Y 7/4) silt loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—50 to 60 inches; pale yellow (2.5Y 7/4) silt loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; few pebbles; few fine threads and filaments of salt; lime disseminated throughout; violent effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 (2 or 3 moist), and chroma of 2 or 3. The Bw horizon has value of 5 to 8 (4 to 6 moist) and chroma of 2 to 4. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam, silty clay loam, or silt loam.

Dimmick Series

The Dimmick series consists of deep, very poorly drained, very slowly permeable soils on uplands. These soils formed in clayey, silty, and loamy alluvium. Slope is 0 to 1 percent.

Typical pedon of Dimmick silty clay, loamy substratum, 1,940 feet north and 490 feet east of the southwest corner of sec. 3, T. 140 N., R. 106 W.

Ap—0 to 6 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; few fine distinct dark yellowish brown (10YR 3/6) mottles; moderate medium angular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; few very fine pores; mildly alkaline; abrupt smooth boundary.

A—6 to 30 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; few very fine distinct dark yellowish brown (10YR 3/6) mottles; moderate medium angular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; few fine and common very fine pores; moderately alkaline; gradual wavy boundary.

ACg—30 to 41 inches; light gray (5Y 6/1) silty clay, gray (5Y 5/1) moist; common fine prominent light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; few fine and many very fine pores; few fine soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg1—41 to 51 inches; white (5Y 8/2) silty clay loam, light olive gray (5Y 6/2) moist; many fine prominent gray (N 5/0) mottles; massive; soft, friable, sticky and plastic; few fine roots; few fine and many very fine pores; lime disseminated throughout and in common fine soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

2Cg2—51 to 60 inches; light gray (5Y 7/1) loam, gray (5Y 5/1) moist; many fine distinct olive (5Y 5/4) mottles; massive; slightly hard, friable, sticky and plastic; few very fine roots; few very fine pores; lime disseminated throughout and in few fine soft masses; violent effervescence; moderately alkaline.

The depth to carbonates ranges from 25 to 35 inches. The A horizon has hue of 10YR to 5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y, value of 5 to 8 (4 to 6 moist), and chroma of 1 or 2. It is silty clay loam or silty clay. The 2C horizon is silt loam or loam.

Flasher Series

The Flasher series consists of shallow, somewhat excessively drained, rapidly permeable soils on uplands. These soils formed in material weathered from sandstone bedrock. Slope ranges from 6 to 45 percent.

Typical pedon of Flasher loamy sand, in an area of Beisigl-Flasher loamy sands, 9 to 15 percent slopes, 275 feet south and 1,200 feet east of the northwest corner of sec. 14, T. 138 N., R. 106 W.

Ap—0 to 6 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, loose, nonsticky and nonplastic; common very fine roots; common fine soft masses of lime; slight effervescence; mildly alkaline; clear smooth boundary.

C—6 to 11 inches; light gray (2.5Y 7/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grain; soft, loose, nonsticky and nonplastic; few very fine roots; few very fine pores; few large pebbles; lime disseminated throughout; strong effervescence; mildly alkaline; clear smooth boundary.

Cr—11 to 60 inches; light gray (5Y 7/2) soft sandstone bedrock, pale olive (5Y 6/3) and light brownish gray

(2.5Y 6/2) moist; strong effervescence; moderately alkaline.

The depth to soft sandstone ranges from 10 to 20 inches. The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3.

Glendive Series

The Glendive series consists of deep, well drained, moderately rapidly permeable soils on flood plains and terraces. These soils formed in stratified, loamy and silty alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Glendive fine sandy loam, 0 to 3 percent slopes, 1,940 feet north and 2,590 feet west of the southeast corner of sec. 36, T. 136 N., R. 105 W.

A—0 to 5 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; few very fine pores; mildly alkaline; clear smooth boundary.

C1—5 to 8 inches; grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) finely stratified loam, grayish brown (10YR 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine and common very fine roots; common very fine pores; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—8 to 15 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) finely stratified silt loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine and common very fine roots; common very fine pores; dark layer about 1 inch thick at a depth of about 15 inches; strong effervescence; mildly alkaline; gradual smooth boundary.

C3—15 to 60 inches; light brownish gray (2.5Y 6/2) and light gray (2.5Y 7/2) finely stratified fine sandy loam, dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine pores; slight effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y and value of 5 or 6 (3 to 5 moist).

Golva Series

The Golva series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty alluvium (fig. 13). Slope ranges from 1 to 6 percent.

Typical pedon of Golva silt loam, 1 to 3 percent slopes, 150 feet south and 2,100 feet east of the northwest corner of sec. 27, T. 138 N., R. 105 W.

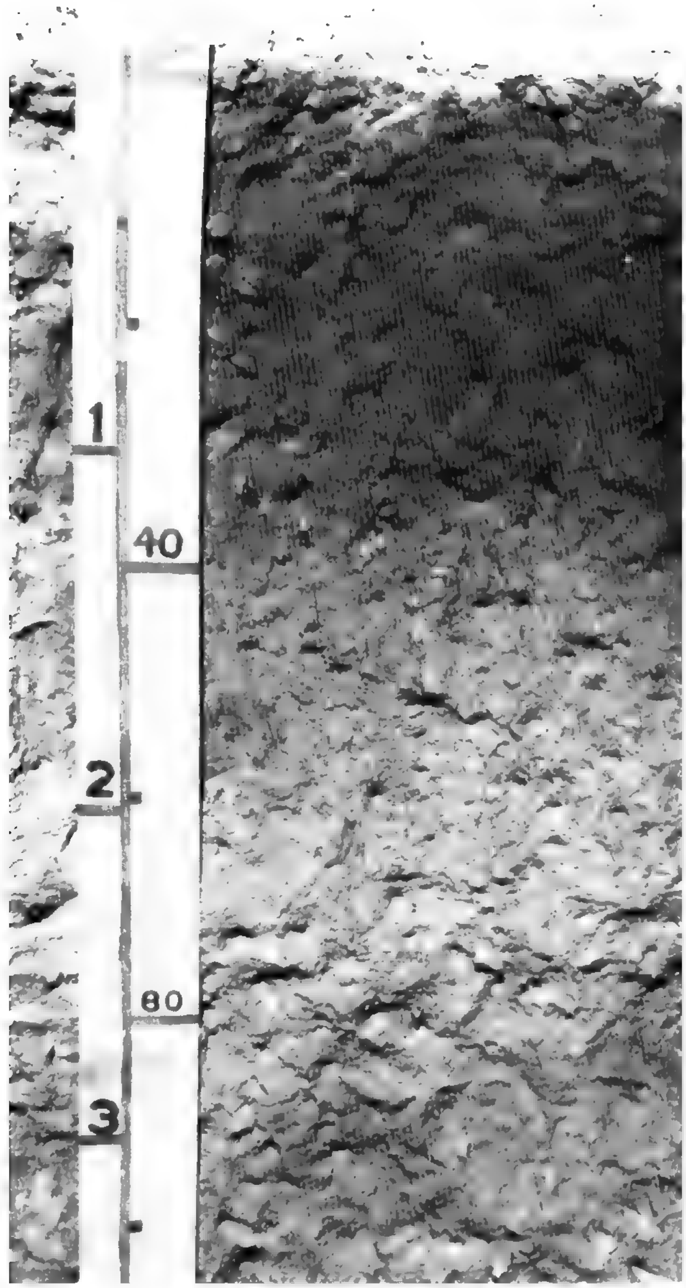


Figure 13.—A profile of Golva silt loam, which formed in alluvium. The dark color of the A horizon extends to a depth of about 15 inches.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; mildly alkaline; abrupt smooth boundary.

Bw1—6 to 12 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many very fine pores; mildly alkaline; clear wavy boundary.

Bw2—12 to 15 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many very fine pores; mildly alkaline; gradual wavy boundary.

Bk—15 to 32 inches; light gray (2.5Y 7/2) silty clay loam, light olive brown (2.5Y 5/4) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C—32 to 60 inches; light gray (2.5Y 7/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y. The C horizon has hue of 10YR or 2.5Y, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4.

Grail Series

The Grail series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in silty and loamy alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Grail silty clay loam, 1 to 3 percent slopes, 540 feet south and 180 feet west of the northeast corner of sec. 8, T. 140 N., R. 105 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure parting to moderate medium granular; slightly hard, very friable, sticky and plastic; many fine and very fine roots; mildly alkaline; abrupt smooth boundary.

A—6 to 9 inches; grayish brown (10YR 5/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, very friable, sticky and plastic; common very fine roots; common very fine pores; mildly alkaline; gradual wavy boundary.

Bt—9 to 19 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; weak coarse prismatic structure; hard, friable, very sticky and very plastic; common very fine roots; common very fine pores; common distinct clay films on faces of peds; mildly alkaline; gradual wavy boundary.

Bk1—19 to 29 inches; light brownish gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; hard, friable, very sticky and very plastic; common very fine roots; common very fine pores; common fine soft masses of lime; strong effervescence; mildly alkaline; gradual wavy boundary.

Bk2—29 to 36 inches; light brownish gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, friable, very sticky and very plastic; few very fine roots; many very fine pores; common fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk3—36 to 46 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, very sticky and very plastic; few very fine roots; common very fine pores; common fine soft masses and filaments of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—46 to 60 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; massive; hard, firm, very sticky and very plastic; few very fine pores; few small scoria fragments; common fine soft masses and filaments of lime; violent effervescence; moderately alkaline.

Some pedons are saline. The A horizon has value of 4 or 5 (2 or 3 moist). The Bt horizon has hue of 10YR or 2.5Y and value of 4 to 6 (2 to 4 moist). It is silty clay or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is silty clay loam, clay loam, sandy clay loam, silt loam, or loam.

Grassna Series

The Grassna series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Grassna silt loam, 1 to 3 percent slopes, 500 feet north and 150 feet west of the southeast corner of sec. 7, T. 139 N., R. 105 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; slightly hard, very friable, slightly sticky and plastic; few very fine roots; very fine pores; mildly alkaline; abrupt smooth boundary.

A—6 to 17 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak

medium subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine roots; common very fine pores; mildly alkaline; clear wavy boundary.

Bw—17 to 23 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, very friable, sticky and plastic; few very fine roots; many very fine pores; few fine soft masses of lime; slight effervescence; mildly alkaline; gradual wavy boundary.

Bk1—23 to 37 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; weak very fine subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine roots; many very fine pores; lime disseminated throughout and in few fine soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—37 to 52 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; weak very fine subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine roots; many very fine pores; lime disseminated throughout and in few fine soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

C—52 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; few very fine pores; many fine threads of lime; strong effervescence; moderately alkaline.

Some pedons are saline. The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 to 4 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. The C horizon has value of 4 to 6 (moist) and chroma of 2 to 4. Some pedons have a buried A horizon below a depth of 50 inches.

Grassna Variant

The Grassna Variant consists of deep, somewhat poorly drained, moderately permeable, strongly saline soils on uplands. These soils formed in clayey, silty, and loamy alluvium. Slope is 0 to 1 percent.

Typical pedon of Grassna Variant silt loam, 1,320 feet south and 920 feet east of the northwest corner of sec. 5, T. 139 N., R. 105 W.

Az1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; few fine nests of salts; strong effervescence; moderately alkaline; clear wavy boundary.

Az2—4 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; few fine distinct brown (10YR 5/3) mottles; moderate medium angular blocky structure parting to moderate medium platy; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; many fine nests and common threads of salts; few fine soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Bwz—16 to 30 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; few fine faint brownish yellow (10YR 6/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; common fine nests and threads of salts; few fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkz1—30 to 38 inches; pale yellow (2.5Y 7/4) silt loam, light olive brown (2.5Y 5/4) moist; few fine faint light brownish gray (10YR 6/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; common fine nests and threads of salts; lime disseminated throughout and in common fine soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkz2—38 to 48 inches; light gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; few fine distinct light yellowish brown (10YR 6/4) mottles; moderate medium and coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; common fine nests and threads of salt crystals; lime disseminated throughout and in common fine soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

Cz—48 to 60 inches; pale yellow (5Y 8/3) silt loam, pale olive (5Y 6/3) moist; few fine prominent light yellowish brown (2.5Y 6/4) mottles; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine pores; common fine nests and few fine threads of salt crystals; lime disseminated throughout and in few fine soft masses; violent effervescence; moderately alkaline.

The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y and value of 4 to 6 (2 to 4 moist). It is silt loam or silty clay loam. The Bk horizon has value of 5 to 8 (3 to 6 moist). It is silt loam, loam, or silty clay loam. The C horizon is silty clay loam, silty clay, or silt loam.

Hanly Series

The Hanly series consists of deep, somewhat excessively drained, rapidly permeable soils on flood

plains and terraces. These soils formed in sandy, silty, and loamy alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Hanly fine sandy loam, 0 to 3 percent slopes, 2,450 feet north and 1,720 feet west of the southeast corner of sec. 36, T. 136 N., R. 105 W.

A—0 to 3 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; clear smooth boundary.

C—3 to 12 inches; brown (10YR 5/3) finely stratified loamy fine sand, dark brown (10YR 4/3) moist; massive; loose, nonsticky and nonplastic; common very fine roots; few very fine pores; slight effervescence; mildly alkaline; clear smooth boundary.

Ab—12 to 15 inches; light brownish gray (10YR 6/2) finely stratified very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; slight effervescence; mildly alkaline; clear wavy boundary.

C'1—15 to 34 inches; light brownish gray (2.5Y 6/2) finely stratified fine sand, dark grayish brown (2.5Y 4/2) moist; massive; loose, nonsticky and nonplastic; few fine and very fine roots; slight effervescence; moderately alkaline; clear wavy boundary.

C'2—34 to 37 inches; light brownish gray (2.5Y 6/2) finely stratified loamy fine sand, dark grayish brown (2.5Y 4/2) moist; massive; soft, loose, nonsticky and nonplastic; few very fine roots; slight effervescence; moderately alkaline; clear wavy boundary.

C'3—37 to 39 inches; light brownish gray (2.5Y 6/2) finely stratified loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; slight effervescence; moderately alkaline; clear wavy boundary.

A'b—39 to 41 inches; light brownish gray (2.5Y 6/2) finely stratified silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, firm, sticky and plastic; few very fine roots; few very fine pores; slight effervescence; moderately alkaline; clear wavy boundary.

C"—41 to 60 inches; light brownish gray (2.5Y 6/2) finely stratified fine sand, dark grayish brown (2.5Y 4/2) moist; massive; soft, loose, nonsticky and nonplastic; few very fine roots; slight effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y and value of 5 or 6 (3 or 4 moist).

Havre Series

The Havre series consists of deep, well drained, moderately permeable soils on flood plains and terraces. These soils formed in silty and loamy alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Havre silt loam, channeled, 2,200 feet south and 810 feet west of the northeast corner of sec. 27, T. 143 N., R. 105 W.

A—0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; soft, very friable, sticky and plastic; common fine and very fine roots; few very fine pores; lime disseminated throughout; strong effervescence; mildly alkaline; clear smooth boundary.

C1—6 to 10 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak very thin platy; slightly hard, very friable, sticky and plastic; common fine and very fine roots; common very fine pores; thin dark layers throughout; lime disseminated throughout; strong effervescence; mildly alkaline; abrupt smooth boundary.

C2—10 to 25 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to moderate thin platy; slightly hard, very friable, sticky and plastic; common fine roots; common very fine pores; thin dark layers throughout; lime disseminated throughout; violent effervescence; mildly alkaline; abrupt smooth boundary.

C3—25 to 32 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; clear wavy boundary.

C4—32 to 54 inches; light brownish gray (2.5Y 6/2) stratified silt loam and silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive with strata separating to weak thin plates; slightly hard, very friable, sticky and plastic; few very fine roots; few very fine pores; lime disseminated throughout; strong effervescence; moderately alkaline; clear wavy boundary.

C5—54 to 60 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; thin dark layers throughout; lime disseminated throughout; violent effervescence; mildly alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. The C horizon has value of 5 or 6 and chroma of 2 or 3. It is loam or

silt loam that has lenses of silty clay loam, fine sandy loam, or sandy loam.

Korchea Series

The Korchea series consists of deep, well drained, moderately permeable soils on flood plains and terraces. These soils formed in silty and loamy alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Korchea silt loam, 0 to 3 percent slopes, 2,350 feet north and 230 feet west of the southeast corner of sec. 27, T. 143 N., R. 105 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak very thin platy structure in the upper 2 inches and weak fine subangular blocky in the lower 4 inches; slightly hard, friable, sticky and plastic; common very fine roots; few very fine pores; lime disseminated throughout; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—6 to 16 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak coarse angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; thin dark layers throughout; lime disseminated throughout and in few fine masses; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ab—16 to 18 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; few fine threads of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

C'—18 to 34 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and medium roots; few very fine pores; thin buried dark layers; few fine threads and masses of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

A'b—34 to 40 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; common fine threads and masses of lime; strong effervescence; moderately alkaline; clear wavy boundary.

C''—40 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; thin dark layers throughout; common fine irregular threads and masses of lime; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The C horizon has value of 4 to 7 (3 to 6 moist) and chroma of 2 to 4. It is loam, silt loam, silty clay loam, fine sandy loam, or very fine sandy loam.

Lawther Series

The Lawther series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in silty and clayey alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Lawther silty clay loam, 3 to 6 percent slopes, 2,140 feet south and 300 feet west of the northeast corner of sec. 19, T. 141 N., R. 103 W.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak fine granular structure; slightly hard, friable, very sticky and very plastic; common very fine roots; few very fine pores; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bw1—5 to 14 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong coarse prismatic structure parting to strong very fine subangular blocky; hard, firm, very sticky and very plastic; few very fine roots; common very fine pores; tongues of A horizon material about 1 inch wide; lime disseminated throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

Bw2—14 to 25 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; common very fine pores; lime disseminated throughout and in few fine soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

Bky—25 to 48 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, friable, very sticky and very plastic; few very fine roots; few very fine pores; many fine masses of gypsum crystals; many large soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—48 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, very sticky and very plastic; few fine masses of gypsum crystals; lime disseminated throughout; strong effervescence; moderately alkaline.

Tongues of the A horizon extend into the B horizon. They are 0.5 inch to 2.0 inches wide. The A horizon has hue of 10YR or 2.5Y and value of 4 or 5 (2 or 3 moist). The Bw and C horizons are silty clay or silty clay loam.

The Bw horizon has hue of 2.5Y or 5Y, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3.

Moreau Series

The Moreau series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from soft siltstone and shale bedrock. Slope ranges from 3 to 9 percent.

Typical pedon of Moreau silty clay loam, in an area of Moreau-Wayden-Absher complex, 3 to 9 percent slopes, 1,650 feet south and 1,200 feet west of the northeast corner of sec. 19, T. 140 N., R. 104 W.

A—0 to 5 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak very fine granular structure; slightly hard, very friable, very sticky and very plastic; many very fine and fine roots; slight effervescence; mildly alkaline; gradual wavy boundary.

Bw1—5 to 10 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak fine prismatic structure parting to strong medium subangular blocky; hard, friable, very sticky and very plastic; many very fine roots; common very fine pores; soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Bw2—10 to 17 inches; pale yellow (5Y 7/3) silty clay, olive (5Y 5/3) moist; strong medium subangular blocky structure; hard, very firm, very sticky and very plastic; common very fine roots; few very fine pores; lime disseminated throughout and in few fine soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

C—17 to 27 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; massive; hard, very firm, very sticky and very plastic; common very fine roots; few very fine pores; few fine salt crystals; few fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—27 to 60 inches; pale yellow (5Y 7/3) and light yellowish brown (2.5Y 6/4) soft siltstone and shale bedrock, olive (5Y 5/3) and light olive brown (2.5Y 5/4) moist; violent effervescence; moderately alkaline.

The depth to soft bedrock ranges from 20 to 40 inches. The A horizon has hue of 2.5Y or 10YR and value of 4 or 5 (2 or 3 moist). The Bw horizon has hue of 10YR to 5Y. The C horizon has hue of 2.5Y or 5Y and value of 5 to 7 (4 to 6 moist). It is silty clay or silty clay loam.

Parshall Series

The Parshall series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy and sandy alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Parshall fine sandy loam, 0 to 3 percent slopes, 410 feet north and 1,295 feet west of the southeast corner of sec. 23, T. 137 N., R. 106 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; about 1 percent coarse fragments; mildly alkaline; abrupt smooth boundary.

A—6 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; about 1 percent coarse fragments; mildly alkaline; clear wavy boundary.

Bw1—10 to 22 inches; brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; about 1 percent gravel; neutral; clear wavy boundary.

Bw2—22 to 39 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; about 1 percent gravel; neutral; gradual wavy boundary.

C—39 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine pores; about 1 percent gravel; lime disseminated throughout; violent effervescence; moderately alkaline.

The depth to carbonates ranges from 24 to 60 inches. The thickness of the mollic epipedon ranges from 16 to 30 inches.

The A horizon has value of 4 or 5 (2 or 3 moist). The Bw horizon has chroma of 2 or 3. Some pedons have a Bk horizon. The C horizon is very fine sandy loam, fine sandy loam, or loamy fine sand.

Regent Series

The Regent series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils

formed in material weathered from soft shale bedrock. Slope ranges from 3 to 6 percent.

Typical pedon of Regent silty clay loam, 3 to 6 percent slopes, 1,590 feet north and 1,620 feet east of the southwest corner of sec. 24, T. 142 N., R. 103 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, sticky and plastic; common fine roots; few very fine pores; neutral; abrupt smooth boundary.

Bt—5 to 15 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, firm, very sticky and very plastic; common fine roots; common very fine pores; common faint clay films on faces of peds; mildly alkaline; clear wavy boundary.

Btk—15 to 25 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, firm, very sticky and very plastic; few very fine roots; common very fine pores; common faint clay films on faces of peds; lime disseminated throughout and in few soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

C—25 to 33 inches; light gray (5Y 7/2) silty clay, olive gray (5Y 5/2) moist; few medium brownish yellow (10YR 6/6) iron stains; massive; hard, firm, very sticky and very plastic; few very fine roots; common very fine pores; violent effervescence; moderately alkaline; gradual irregular boundary.

Cr—33 to 60 inches; light gray (5Y 7/2) and gray (5Y 6/1) soft shale bedrock, olive gray (5Y 5/2) and dark gray (5Y 4/1) moist; common medium brownish yellow (10YR 6/6) iron stains; violent effervescence; moderately alkaline.

The depth to shale bedrock ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 16 inches.

The A horizon has value of 4 or 5 (2 or 3 moist). The Bt and C horizons are silty clay loam or silty clay.

Sen Series

The Sen series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft siltstone bedrock. Slope ranges from 1 to 6 percent.

Typical pedon of Sen silt loam, 1 to 3 percent slopes, 2,420 feet south and 90 feet east of the northwest corner of sec. 33, T. 138 N., R. 104 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and plastic; few very fine roots; few very fine pores; neutral; abrupt smooth boundary.

Bw1—6 to 14 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, slightly sticky and plastic; few very fine roots; common very fine pores; neutral; gradual wavy boundary.

Bw2—14 to 22 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak fine prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, slightly sticky and plastic; few very fine roots; common very fine pores; neutral; gradual wavy boundary.

Bk—22 to 33 inches; white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) moist; moderate medium subangular blocky structure; hard, very friable, slightly sticky and plastic; few very fine roots; common very fine pores; lime disseminated throughout and in common medium soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

C—33 to 38 inches; pale yellow (5Y 7/3) silt loam, pale olive (5Y 6/3) moist; massive; hard, very friable, slightly sticky and slightly plastic; common very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—38 to 60 inches; pale yellow (5Y 8/4 and 7/3) soft siltstone bedrock, pale olive (5Y 6/3) and light yellowish brown (2.5Y 6/4) moist; violent effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The depth to carbonates ranges from 10 to 30 inches. The depth to soft bedrock ranges from 20 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silt loam or loam. The Bk and C horizons have hue of 2.5Y or 5Y, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4.

Shambo Series

The Shambo series consists of deep, well drained, moderately permeable soils on terraces and uplands. These soils formed in loamy alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Shambo loam, 1 to 3 percent slopes, 2,400 feet north and 850 feet west of the southeast corner of sec. 31, T. 139 N., R. 103 W.

A—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak very fine

granular structure; slightly hard, very friable, slightly sticky and plastic; many fine and very fine roots; few very fine pores; neutral; gradual wavy boundary.

Bw1—5 to 10 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; slightly hard, very friable, slightly sticky and plastic; many very fine roots; few very fine pores; neutral; gradual wavy boundary.

Bw2—10 to 15 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky and plastic; common very fine roots; common very fine pores; about 1 percent gravel; few fine soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk—15 to 36 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and plastic; few very fine roots; common very fine pores; about 2 percent gravel; lime disseminated throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—36 to 42 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; massive; hard, very friable, slightly sticky and plastic; few very fine roots; common very fine pores; about 5 percent gravel; lime disseminated throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

2C2—42 to 60 inches; light brown (7.5YR 6/4) gravelly loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, loose, nonsticky and nonplastic; few very fine roots; few very fine pores; about 25 percent gravel; lime disseminated throughout; strong effervescence; strongly alkaline.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. The Bk horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam or silt loam. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. Some pedons do not have a 2C horizon.

Vebar Series

The Vebar series consists of moderately deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in material weathered from soft sandstone bedrock. Slope ranges from 1 to 9 percent.

Typical pedon of Vebar fine sandy loam, 1 to 6 percent slopes, 410 feet south and 925 feet west of the northeast corner of sec. 25, T. 137 N., R. 106 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky and strong coarse granular structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots; few very fine pores; mildly alkaline; abrupt smooth boundary.

A—8 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots; common very fine pores; mildly alkaline; clear smooth boundary.

Bw1—11 to 15 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; mildly alkaline; clear wavy boundary.

Bw2—15 to 22 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; small animal burrow, 3 inches in diameter, at a depth of about 16 inches; mildly alkaline; gradual wavy boundary.

Bk—22 to 26 inches; light gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; lime disseminated throughout and in common fine soft masses; violent effervescence; mildly alkaline; gradual wavy boundary.

C—26 to 38 inches; light gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; large piece of petrified wood at a depth of about 33 inches; lime disseminated throughout and in many fine soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—38 to 60 inches; very pale brown (10YR 7/4) and pale yellow (2.5Y 7/3) soft sandstone bedrock, yellowish brown (10YR 5/4) and light olive brown (2.5Y 5/3) moist; violent effervescence; moderately alkaline.

The depth to soft sandstone bedrock ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 16 inches.

The A horizon has value of 3 to 5 and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 5.

Wanagan Series

The Wanagan series consists of deep, well drained, moderately permeable soils on terraces and outwash plains. These soils formed in loamy alluvium and outwash sediments. Slope ranges from 1 to 6 percent.

Typical pedon of Wanagan loam, 1 to 3 percent slopes, 1,250 feet south and 1,700 feet east of the northwest corner of sec. 17, T. 141 N., R. 105 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak thin platy structure; slightly hard, very friable, sticky and plastic; few very fine roots; slightly acid; abrupt smooth boundary.

Bw—7 to 14 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; about 2 percent gravel; mildly alkaline; clear wavy boundary.

Bk—14 to 18 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; about 5 percent gravel; lime disseminated throughout; violent effervescence; mildly alkaline; clear wavy boundary.

2BCk—18 to 26 inches; very pale brown (10YR 7/3) and brown (10YR 5/3) very gravelly sandy clay loam, pale brown (10YR 6/3) and dark brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; about 40 percent gravel; about 5 percent cobbles; lime disseminated throughout and in common fine soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

2C1—26 to 39 inches; pale brown (10YR 6/3) very gravelly fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; about 60 percent gravel; about 5 percent cobbles; lime disseminated throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

2C2—39 to 50 inches; pale brown (10YR 6/3) very gravelly fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; about 50 percent gravel; about 5 percent cobbles; lime disseminated throughout; strong effervescence; moderately alkaline; clear wavy boundary.

3C3—50 to 60 inches; light brownish gray (2.5Y 6/2) extremely gravelly loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; about 60 percent gravel; about 5 percent cobbles; lime disseminated throughout; violent effervescence; moderately alkaline.

The depth to a layer in which the content of gravel is 35 percent or more ranges from 16 to 28 inches. The A horizon has value of 4 or 5 (2 or 3 moist). The Bw horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. The BCk horizon has hue of 10YR or 2.5Y. The content of gravel in the 2C horizon ranges from 35 to 85 percent and the content of cobbles from 5 to 30 percent.

Wayden Series

The Wayden series consists of shallow, well drained, slowly permeable soils on uplands. These soils formed in material weathered from soft shale bedrock. Slope ranges from 3 to 9 percent.

Typical pedon of Wayden silty clay, in an area of Moreau-Wayden-Absher complex, 3 to 9 percent slopes, 300 feet south and 840 feet east of the northwest corner of sec. 3, T. 137 N., R. 104 W.

Ap—0 to 5 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; moderate very fine granular structure; hard, firm, sticky and plastic; common very fine roots; common very fine pores; strong effervescence; moderately alkaline; abrupt smooth boundary.

C—5 to 11 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; moderate very fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine pores; slight effervescence; mildly alkaline; gradual irregular boundary.

Cr—11 to 60 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) soft shale bedrock; violent effervescence; moderately alkaline.

The depth to soft shale bedrock ranges from 10 to 20 inches. The A horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Anna, Lawrence O. 1981. Ground-water resources of Billings, Golden Valley, and Slope Counties, North Dakota. U.S. Geol. Surv., 56 pp., illus.

(4) Austin, Morris E. 1965. Land resource regions and major land resource areas of the United States. U.S. Dep. Agric. Handb. 296, 82 pp., map.

(5) Brown, Al, and Jim Krall. 1979. Saline seep handbook. Mont. State Univ., Coop. Ext. Serv. Bull. 1205, 13 pp., illus.

(6) Cairns, R.R., and W.E. Bowser. 1978. Solonetzic soils and their management. Can. Dep. Agric. Pub. 1391, 37 pp., illus.

(7) Carver, Robert F., and William G. Hamlin. 1984. North Dakota agricultural statistics—1984. N. Dak. Crop and Livest. Rep. Serv. Agric. Stat. 53, 96 pp.

(8) Clayton, Lee. 1980. Geologic map of North Dakota. N. Dak. Geol. Surv.

(9) Golden Valley County Planning Commission. 1979. Comprehensive plan—Golden Valley County, North Dakota. Volume I: Characteristics and background. 243 pp., illus.

(10) Jakes, Pamela J., and W. Brad Smith. 1982. A second look at North Dakota's timber land. U.S. Dep. Agric., Forest Serv., Resour. Bull. NC-58, 86 pp.

(11) Lapham, Macy H., and others. 1910. Soil survey of western North Dakota. U.S. Dep. Agric., Bur. of Soils, 80 pp., illus.

(12) Sherman, William C. 1983. Prairie mosaic: An ethnic atlas of rural North Dakota. N. Dak. Inst. for Reg. Stud., 152 pp.

(13) Thompson, Kenneth, R. Gilman, and J. Clapper. 1979. Soil survey, west-central area, Golden Valley County, North Dakota. U.S. Dep. Agric., Soil Conserv. Serv., 174 pp. (Supplement issued 1980)

(14) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(15) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(16) United States Department of Agriculture. 1981. Saline seep genesis, identification, and control. Soil Conserv. Serv. Circ. ND 190-1, 8 pp., illus.

Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be

limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Porcelainite. An indurated or baked clay or shale with a dull, light colored, cherty appearance; often found in the roof or floor of a burned-out coal seam.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a

soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Generally, the E horizon. If this horizon is at the surface, it is called a surface layer.

Surface layer. An A horizon 10 or less inches thick. Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. An A horizon 10 or more inches thick.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1960-81 at Trotters, North Dakota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	20.7	0.6	10.7	52	-33	20	0.35	0.12	0.53	1	5.6
February---	28.4	8.3	18.4	56	-25	14	.33	.10	.52	1	3.8
March------	39.4	17.7	28.6	73	-18	66	.41	.13	.64	1	4.3
April------	54.4	30.1	42.3	85	8	178	1.25	.50	1.89	4	4.3
May--------	66.4	41.1	53.8	92	23	432	2.23	.90	3.33	5	.8
June-------	75.8	50.6	63.2	96	37	696	3.64	2.50	4.67	6	.0
July-------	83.6	55.6	69.6	103	43	918	1.72	.85	2.46	5	.0
August-----	82.7	53.4	68.1	100	38	871	1.52	.28	2.47	3	.0
September--	70.7	43.5	57.1	96	24	522	1.59	.42	2.52	4	.4
October----	58.4	33.7	46.1	84	14	235	.79	.16	1.29	2	1.6
November---	39.7	19.1	29.4	67	-12	31	.42	.11	.67	2	4.4
December---	26.4	7.3	16.9	56	-31	11	.40	.19	.57	1	5.6
Yearly:											
Average--	53.9	30.1	42.0	---	---	---	---	---	---	---	---
Extreme--	---	---	---	103	-34	---	---	---	---	---	---
Total----	---	---	---	---	---	3,994	14.65	12.15	17.03	35	30.8

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1960-81 at Trotters, North Dakota)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 9	May 21	May 30
2 years in 10 later than--	May 4	May 16	May 24
5 years in 10 later than--	Apr. 25	May 6	May 14
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 25	Sept. 16	Sept. 1
2 years in 10 earlier than--	Oct. 1	Sept. 22	Sept. 8
5 years in 10 earlier than--	Oct. 12	Oct. 3	Sept. 21

TABLE 3.--GROWING SEASON

(Recorded in the period 1960-81 at Trotters, North Dakota)

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	146	124	105
8 years in 10	154	133	114
5 years in 10	169	149	130
2 years in 10	184	166	146
1 year in 10	192	174	154

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
3	Havre silt loam, channeled	15,790	2.4
4	Grassna silt loam, 1 to 3 percent slopes	4,660	0.7
6	Grassna Variant silt loam	1,520	0.2
9C	Cabba-Chama silt loams, 3 to 9 percent slopes	11,660	1.8
9D	Cabba-Chama silt loams, 9 to 15 percent slopes	26,890	4.1
10F	Cabbart-Badland complex, 15 to 50 percent slopes	93,770	14.5
11F	Brandenburg-Cabbart complex, 6 to 50 percent slopes	29,580	4.6
12	Hanly fine sandy loam, 0 to 3 percent slopes	130	*
14F	Baahish-Cabbart loams, 6 to 25 percent slopes	2,090	0.3
19F	Cabbart-Cherry silt loams, 9 to 35 percent slopes	91,460	14.1
20	Chama silt loam, 1 to 3 percent slopes	3,590	0.6
20B	Chama silt loam, 3 to 6 percent slopes	32,710	5.0
21C	Chama-Cabba silt loams, 3 to 9 percent slopes	68,410	10.6
24B	Cherry silt loam, 3 to 6 percent slopes	6,980	1.1
24C	Cherry silt loam, 6 to 9 percent slopes	9,010	1.4
26	Dimmick silty clay, loamy substratum	620	0.1
35F	Flasher loamy sand, 15 to 45 percent slopes	17,790	2.7
37	Golva silt loam, 1 to 3 percent slopes	33,520	5.2
37B	Golva silt loam, 3 to 6 percent slopes	25,240	3.9
41	Grail silty clay loam, 1 to 3 percent slopes	2,200	0.3
45	Havre silt loam, 0 to 3 percent slopes	850	0.1
46	Glendive fine sandy loam, 0 to 3 percent slopes	390	0.1
47	Korchea silt loam, 0 to 3 percent slopes	3,470	0.5
52B	Belfield loam, 1 to 6 percent slopes	11,820	1.8
55	Wanagan loam, 1 to 3 percent slopes	2,610	0.4
55B	Wanagan loam, 3 to 6 percent slopes	1,670	0.3
57C	Moreau-Wayden-Absher complex, 3 to 9 percent slopes	5,690	0.9
72	Parshall fine sandy loam, 0 to 3 percent slopes	1,420	0.2
76B	Regent silty clay loam, 3 to 6 percent slopes	860	0.1
80B	Absher loam, 1 to 6 percent slopes	11,820	1.8
81F	Cabbart-Rock outcrop complex, 15 to 120 percent slopes	2,580	0.4
83F	Badland-Cherry complex, 6 to 75 percent slopes	65,930	10.2
84	Lawther silty clay loam, 1 to 3 percent slopes	1,680	0.3
84B	Lawther silty clay loam, 3 to 6 percent slopes	2,090	0.3
88	Sen silt loam, 1 to 3 percent slopes	1,950	0.3
88B	Sen silt loam, 3 to 6 percent slopes	2,590	0.4
89	Shambo loam, 1 to 3 percent slopes	4,340	0.7
89B	Shambo loam, 3 to 6 percent slopes	3,540	0.5
97B	Vebar fine sandy loam, 1 to 6 percent slopes	6,030	0.9
97C	Vebar fine sandy loam, 6 to 9 percent slopes	2,280	0.4
99C	Beisigl-Flasher-Vebar complex, 3 to 9 percent slopes	11,990	1.8
99D	Beisigl-Flasher loamy sands, 9 to 15 percent slopes	11,440	1.8
109B	Amor loam, 3 to 6 percent slopes	3,970	0.6
109C	Amor loam, 6 to 9 percent slopes	3,100	0.5
114	Grail-Grassna complex, saline	6,660	1.0
	Water	570	0.1
	Total	648,960	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Sunflowers	Wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
3. Havre	---	---	---	---	---	2.2
4. Grassna	31	66	50	16	1,550	2.4
6. Grassna Variant	---	---	---	---	---	0.8
9C. Cabba-Chama	---	---	---	---	---	0.9
9D. Cabba-Chama	---	---	---	---	---	0.9
10F*. Cabbart-Badland						
11F. Brandenburg-Cabbart						
12. Hanly	14	30	23	7	700	1.3
14F. Baahish-Cabbart						
19F. Cabbart-Cherry						
20. Chama	23	49	37	12	1,150	1.4
20B. Chama	20	43	33	10	1,000	1.4
21C. Chama-Cabba	12	26	20	6	600	1.0
24B. Cherry	21	45	34	11	1,050	1.8
24C. Cherry	17	36	28	9	850	1.8
26**. Dimmick	12	26	20	6	600	---
35F. Flasher						
37. Golva	31	66	50	16	1,550	1.8
37B. Golva	27	57	44	14	1,350	1.8

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Sunflowers	Wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
41----------------------- Grail	31	66	50	16	1,550	2.4
45----------------------- Havre	26	55	42	13	1,300	1.8
46----------------------- Glendive	20	43	33	10	1,000	1.4
47----------------------- Korchea	27	57	44	14	1,350	1.8
52B---------------------- Belfield	20	43	33	10	1,000	1.3
55----------------------- Wanagan	19	40	31	10	950	1.3
55B---------------------- Wanagan	15	32	24	8	750	1.3
57C---------------------- Moreau-Wayden-Absher	10	21	16	5	500	0.8
72----------------------- Parshall	21	45	34	11	1,050	1.4
76B---------------------- Regent	23	49	37	12	1,150	1.4
80B---------------------- Absher	---	---	---	---	---	0.6
81F*. Cabbart-Rock outcrop						
83F. Badland-Cherry						
84----------------------- Lawther	27	57	44	14	1,350	1.6
84B---------------------- Lawther	21	45	34	11	1,050	1.6
88----------------------- Sen	27	57	44	14	1,350	1.4
88B---------------------- Sen	23	49	37	12	1,150	1.4
89----------------------- Shambo	26	55	42	13	1,300	1.8
89B---------------------- Shambo	24	51	39	12	1,200	1.8
97B---------------------- Vebar	18	38	29	9	900	1.3

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Sunflowers	Wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
97C------------------------ Vebar	14	30	23	7	700	1.2
99C------------------------ Beisigl-Flasher-Vebar	11	23	18	6	550	1.0
99D------------------------ Beisigl-Flasher	---	---	---	---	---	0.8
109B----------------------- Amor	25	53	41	13	1,250	1.4
109C----------------------- Amor	18	38	29	9	900	1.4
114------------------------ Grail-Grassna	15	32	24	8	750	1.1

* See description of the map unit for composition and behavior characteristics of the map unit.
** Yields are for undrained areas.

TABLE 6.--RANGELAND PRODUCTIVITY

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
3 Havre	Overflow	2,700	2,400	2,000
4 Grassna	Overflow	3,400	2,900	2,400
6 Grassna Variant	Saline Lowland	2,600	2,200	1,800
9C*, 9D*:				
Cabba	Shallow	1,700	1,500	1,200
Chama	Silty	2,300	2,000	1,700
10F*:				
Cabbart	Shallow	1,400	1,200	900
Badland.				
11F*:				
Brandenburg	Very Shallow	900	700	500
Cabbart	Shallow	1,400	1,200	900
12 Hanly	Thin Sands	1,400	1,200	1,000
14F*:				
Baahish	Very Shallow	900	700	500
Cabbart	Shallow	1,400	1,200	900
19F*:				
Cabbart	Shallow	1,400	1,200	900
Cherry	Silty	2,300	2,000	1,700
20, 20B Chama	Silty	2,300	2,000	1,700
21C*:				
Chama	Silty	2,300	2,000	1,700
Cabba	Shallow	1,700	1,500	1,200
24B, 24C Cherry	Silty	2,300	2,000	1,700
26 Dimmick	Wetland	5,700	5,200	4,700
35F Flasher	Shallow	1,700	1,500	1,200
37, 37B Golva	Silty	2,300	2,000	1,700

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
41 Grail	Overflow	3,400	2,900	2,400
45 Havre	Silty	1,900	1,600	1,300
46 Glendive	Sandy	2,000	1,700	1,400
47 Korchea	Silty	2,300	2,000	1,700
52B Belfield	Clayey	2,300	2,000	1,700
55, 55B Wanagan	Silty	2,300	2,000	1,700
57C*:				
Moreau	Clayey	2,300	2,000	1,700
Wayden	Shallow Clay	1,200	1,000	800
Absher	Thin Claypan	700	500	300
72 Parshall	Sandy	2,400	2,100	1,800
76B Regent	Clayey	2,300	2,000	1,700
80B Absher	Thin Claypan	700	500	300
81F*:				
Cabbart	Shallow	1,400	1,200	900
Rock outcrop.				
83F*:				
Badland.				
Cherry	Silty	2,300	2,000	1,700
84, 84B Lawther	Clayey	2,300	2,000	1,700
88, 88B Sen	Silty	2,300	2,000	1,700
89, 89B Shambo	Silty	2,300	2,000	1,700
97B, 97C Vebar	Sandy	2,400	2,100	1,800
99C*:				
Beisigl	Sands	2,500	2,300	2,000
Flasher	Shallow	1,700	1,500	1,200

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
99C*:				
Vebar	Sandy	2,400	2,100	1,800
99D*:				
Beisigl	Sands	2,500	2,300	2,000
Flasher	Shallow	1,700	1,500	1,200
109B, 109C Amor	Silty	2,300	2,000	1,700
114*:				
Grail	Saline Lowland	3,000	2,600	2,200
Grassna	Saline Lowland	3,000	2,600	2,200

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
3 Havre	---	Rocky Mountain juniper, common chokecherry, Tatarian honeysuckle, eastern redcedar, Siberian peashrub.	Ponderosa pine, Black Hills spruce, blue spruce, American elm, green ash.	Siberian elm	Eastern cottonwood.
4 Grassna	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
6. Grassna Variant					
9C*, 9D*: Cabba.					
Chama	---	Black Hills spruce, eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum, common chokecherry, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
10F*: Cabbart.					
Badland.					
11F*: Brandenburg.					
Cabbart.					
12 Hanly	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
14F*: Baahish.					
Cabbart.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
19F*: Cabbart.					
Cherry	---	Eastern redcedar, lilac, Russian-olive, Siberian peashrub, common chokecherry, Black Hills spruce, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
20, 20B Chama	---	Black Hills spruce, eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum, common chokecherry, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
21C*: Chama	---	Black Hills spruce, eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum, common chokecherry, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
Cabba.					
24B, 24C Cherry	---	Eastern redcedar, lilac, Russian-olive, Siberian peashrub, common chokecherry, Black Hills spruce, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
26 Dimmick	Siberian peashrub, Tatarian honeysuckle, redosier dogwood, American plum.	Black Hills spruce, common chokecherry, Siberian crabapple, lilac, eastern redcedar.	---	Golden willow, green ash.	Plains cottonwood.
35F. Flasher					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
37, 37B Golva	---	Black Hills spruce, eastern redcedar, Russian-olive, Siberian peashrub, common chokecherry, Rocky Mountain juniper, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
41 Grail	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
45 Havre	---	Rocky Mountain juniper, common chokecherry, Tatarian honeysuckle, eastern redcedar, Siberian peashrub.	Ponderosa pine, Black Hills spruce, blue spruce, American elm, green ash.	Siberian elm	Eastern cottonwood.
46 Glendive	Skunkbush sumac	Siberian peashrub, ponderosa pine, Tatarian honeysuckle, green ash, silver buffaloberry, Rocky Mountain juniper, lilac, common chokecherry, blue spruce.	Siberian elm, Russian-olive.	---	---
47 Korchea	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
52B Belfield	Siberian peashrub, golden currant, American plum, lilac.	Green ash, eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
55, 55B. Wanagan	---	Russian-olive, American plum, Black Hills spruce, Tatarian honeysuckle, lilac, eastern redcedar, Siberian peashrub, common chokecherry.	Bur oak, ponderosa pine, green ash, Siberian crabapple.	---	---
57C*:					
Moreau	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Wayden.					
Absher.					
72. Parshall	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
76B. Regent	Siberian peashrub, lilac, American plum, golden currant.	Ponderosa pine, green ash, Russian-olive, common chokecherry, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---	---
80B. Absher					
81F*:					
Cabbart.					
Rock outcrop.					
83F*:					
Badland.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
83F*:					
Cherry	---	Eastern redcedar, lilac, Russian-olive, Siberian peashrub, common chokecherry, Black Hills spruce, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
84, 84B Lawther	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry, eastern redcedar.	Siberian elm	---	---
88, 88B Sen	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Siberian crabapple, bur oak, green ash, ponderosa pine.	---	---
89, 89B Shambo	---	Black Hills spruce, eastern redcedar, Russian-olive, Siberian peashrub, common chokecherry, lilac, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
97B, 97C Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---
99C*:					
Beisigl.					
Flasher.					
Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
99D*: Beisigl.					
Flasher.					
109B, 109C: Amor	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
114*: Grail	Silver buffaloberry, Siberian peashrub.	Russian-olive, green ash, Siberian elm.	---	---	---
Grassna	Silver buffaloberry, Siberian peashrub.	Russian-olive, green ash, Siberian elm.	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
3 Havre	Severe: flooding.	Moderate: dusty.	Moderate: slope, flooding.	Moderate: dusty.
4 Grassna	Slight	Slight	Moderate: slope.	Slight.
6 Grassna Variant	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness.
9C*:				
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
Chama	Slight	Slight	Severe: slope.	Slight.
9D*:				
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
Chama	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
10F*:				
Cabbart	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Badland.				
11F*:				
Brandenburg	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.
Cabbart	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
12 Hanly	Severe: flooding.	Slight	Moderate: flooding.	Slight.
14F*:				
Baahish	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Cabbart	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
19F*:				
Cabbart	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
19F*:				
Cherry	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
20, 20B Chama	Slight	Slight	Moderate: slope, depth to rock.	Slight.
21C*:				
Chama	Slight	Slight	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
24B Cherry	Slight	Slight	Moderate: slope.	Severe: erodes easily.
24C Cherry	Slight	Slight	Severe: slope.	Severe: erodes easily.
26 Dimmick	Severe: ponding, percs slowly, too clayey.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.
35F Flasher	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
37, 37B Golva	Slight	Slight	Moderate: slope.	Slight.
41 Grail	Slight	Slight	Moderate: slope.	Slight.
45 Havre	Severe: flooding.	Moderate: dusty.	Moderate: flooding.	Moderate: dusty.
46 Glendive	Severe: flooding.	Slight	Moderate: flooding.	Slight.
47 Korchea	Severe: flooding.	Slight	Slight	Slight.
52B Belfield	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
55, 55B Wanagan	Slight	Slight	Moderate: slope.	Slight.
57C*:				
Moreau	Slight	Slight	Severe: slope.	Slight.
Wayden	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: too clayey.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
57C*:				
Absher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.
72 Parshall	Slight	Slight	Slight	Slight.
76B Regent	Slight	Slight	Moderate: slope.	Slight.
80B Absher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.
81F*:				
Cabbart	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Rock outcrop.				
83F*:				
Badland.				
Cherry	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
84, 84B Lawther	Slight	Slight	Moderate: slope.	Slight.
88, 88B Sen	Slight	Slight	Moderate: slope, depth to rock.	Slight.
89, 89B Shambo	Slight	Slight	Moderate: slope.	Slight.
97B Vebar	Slight	Slight	Moderate: slope, depth to rock.	Slight.
97C Vebar	Slight	Slight	Severe: slope.	Slight.
99C*:				
Beisigl	Slight	Slight	Severe: slope.	Slight.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Vebar	Slight	Slight	Severe: slope.	Slight.
99D*:				
Beisigl	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
109B: Amor	Slight	Slight	Moderate: slope, depth to rock.	Slight.
109C: Amor	Slight	Slight	Severe: slope.	Slight.
114*:				
Grail	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
Grassna	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
3 Havre	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
4 Grassna	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
6 Grassna Variant	Poor	Fair	Very poor	Very poor	Fair	Fair	Poor	Fair	Very poor.
9C*, 9D*:									
Cabba	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Chama	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
10F*:									
Cabbart	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Badland.									
11F*:									
Brandenburg	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Cabbart	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
12 Hanly	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
14F*:									
Baahish	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Cabbart	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
19F*:									
Cabbart	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Cherry	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
20, 20B Chama	Good	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
21C*:									
Chama	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Cabba	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
24B, 24C Cherry	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
26 Dimmick	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
35F Flasher	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
37, 37B Golva	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
41----------------- Grail	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
45----------------- Havre	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
46----------------- Glendive	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
47----------------- Korchea	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
52B---------------- Belfield	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
55, 55B------------ Wanagan	Good	Good	Good	Fair	Poor	Fair	Good	Poor	Fair.
57C*:									
Moreau------------	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
Wayden------------	Poor	Fair	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
Absher------------	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor.
72----------------- Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
76B---------------- Regent	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
80B---------------- Absher	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor.
81F*:									
Cabbart-----------	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop.									
83F*:									
Badland.									
Cherry------------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
84----------------- Lawther	Good	Good	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
84B---------------- Lawther	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
88, 88B------------ Sen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
89, 89B------------ Shambo	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
97B, 97C----------- Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
99C*:									
Beisigl	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Flasher	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
99D*:									
Beisigl	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Flasher	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
109B, 109C Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
114*:									
Grail	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair	Very poor	Very poor.
Grassna	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair	Very poor	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
3 Havre	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
4 Grassna	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
6 Grassna Variant	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.
9C*:					
Cabba	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.
Chama	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
9D*:					
Cabba	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, shrink-swell, slope.
Chama	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
10F*:					
Cabbart	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Badland.					
11F*:					
Brandenburg	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
Cabbart	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
12 Hanly	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
14F*:					
Baahish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
14F*:					
Cabbart	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
19F*:					
Cabbart	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Cherry	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
20 Chama	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
20B Chama	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
21C*:					
Chama	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cabba	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.
24B, 24C Cherry	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
26 Dimmick	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
35F Flasher	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
37 Golva	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
37B Golva	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
41 Grail	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
45 Havre	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
46 Glendive	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
47---------------- Korchea	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: low strength, flooding, frost action.
52B--------------- Belfield	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
55---------------- Wanagan	Slight-----------	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
55B--------------- Wanagan	Slight-----------	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action.
57C*:					
Moreau-----------	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Wayden-----------	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Absher-----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
72---------------- Parshall	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
76B--------------- Regent	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
80B--------------- Absher	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
81F*:					
Cabbart----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
83F*:					
Badland.					
Cherry-----------	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
84, 84B----------- Lawther	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
88---------------- Sen	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
88B-----------------Sen	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
89-----------------Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.
89B-----------------Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
97B-----------------Vebar	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Slight	Slight.
97C-----------------Vebar	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
99C*:					
Beisigl	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
Flasher	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.
Vebar	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
99D*:					
Beisigl	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
Flasher	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
109B, 109C-----------Amor	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
114*:					
Grail	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Grassna	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
3 Havre	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
4 Grassna	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
6 Grassna Variant	Severe: wetness.	Severe: wetness.	Severe: wetness, excess salt.	Severe: wetness.	Poor: wetness, excess salt.
9C*: Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Chama	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
9D*: Cabba	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Chama	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
10F*: Cabbart	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Badland.					
11F*: Brandenburg	Severe: poor filter, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Cabbart	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
12 Hanly	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy.
14F*: Baahish	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
14F*:					
Cabbart	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
19F*:					
Cabbart	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Cherry	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
20, 20B Chama	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
21C*:					
Chama	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
24B Cherry	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
24C Cherry	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
26 Dimmick	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
35F Flasher	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
37, 37B Golva	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
41 Grail	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
45 Havre	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
46 Glendive	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding.	Severe: flooding.	Fair: too sandy.
47 Korchea	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
52B-----------------Belfield	Severe: percs slowly.	Severe: seepage.	Severe: seepage, too clayey, excess sodium.	Slight-----------	Poor: too clayey, hard to pack, excess sodium.
55, 55B-------------Wanagan	Moderate: percs slowly.	Moderate: seepage.	Slight-----------	Slight-----------	Poor: small stones.
57C*:					
Moreau-------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Wayden-------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Absher-------------	Severe: percs slowly.	Moderate: slope.	Severe: excess salt.	Slight-----------	Poor: hard to pack.
72-----------------Parshall	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
76B-----------------Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
80B-----------------Absher	Severe: percs slowly.	Moderate: slope.	Severe: excess salt.	Slight-----------	Poor: hard to pack.
81F*:					
Cabbart------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Rock outcrop.					
83F*:					
Badland.					
Cherry-------------	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
84, 84B-------------Lawther	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
88, 88B-------------Sen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
89, 89B-------------Shambo	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey.
97B-----------------Vebar	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
97C Vebar	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
99C*:					
Beisigl	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, too sandy.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
Vebar	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
99D*:					
Beisigl	Severe: depth to rock, poor filter	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, too sandy.
Flasher	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
109B Amor	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
109C Amor	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
114*:					
Grail	Severe: percs slowly.	Moderate: wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Grassna	Moderate: wetness, percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
3 Havre	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
4 Grassna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
6 Grassna Variant	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
9C*:				
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock.
9D*:				
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, slope.
10F*:				
Cabbart	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Badland.				
11F*:				
Brandenburg	Poor: large stones, slope.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: small stones, area reclaim, slope.
Cabbart	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
12 Hanly	Good	Probable	Improbable: too sandy.	Poor: thin layer.
14F*:				
Baahish	Fair: large stones, slope.	Probable	Probable	Poor: area reclaim, small stones, slope.
Cabbart	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
19F*:				
Cabbart	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Cherry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
20, 20B Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock.
21C*:				
Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
24B, 24C Cherry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
26 Dimmick	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
35F Flasher	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
37, 37B Golva	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
41 Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
45 Havre	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
46 Glendive	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
47 Korchea	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
52B Belfield	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
55, 55B Wanagan	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
57C*:				
Moreau	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
57C*:				
Wayden	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey.
Absher	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
72 Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
76B Regent	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
80B Absher	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
81F*:				
Cabbart	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Rock outcrop.				
83F*:				
Badland.				
Cherry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
84, 84B Lawther	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
88, 88B Sen	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
89, 89B Shambo	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
97B, 97C Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
99C*:				
Beisigl	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Flasher	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
99D*:				
Beisigl	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Flasher	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
109B, 109C Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
114*:				
Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Grassna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
3------------------ Havre	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Too arid, erodes easily.
4------------------ Grassna	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
6------------------ Grassna Variant	Moderate: seepage.	Severe: piping, wetness, excess salt.	Excess salt----	Wetness, droughty, excess salt.	Wetness--------	Wetness, excess salt, droughty.
9C*:						
Cabba------------	Severe: depth to rock.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Chama------------	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
9D*:						
Cabba------------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Chama------------	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
10F*:						
Cabbart----------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Badland.						
11F*:						
Brandenburg------	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
Cabbart----------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
12----------------- Hanly	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty-------	Too sandy, soil blowing.	Droughty.
14F*:						
Baahish----------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, droughty, soil blowing.	Slope, large stones, soil blowing.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
14F*:						
Cabbart	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
19F*:						
Cabbart	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Cherry	Severe: slope.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
20 Chama	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock	Depth to rock, erodes easily.	Erodes easily, depth to rock.
20B Chama	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
21C*:						
Chama	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Cabba	Severe: depth to rock.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
24B, 24C Cherry	Moderate: slope.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
26 Dimmick	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
35F Flasher	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
37 Golva	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
37B Golva	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
41 Grail	Slight	Moderate: piping, hard to pack.	Deep to water	Percs slowly	Percs slowly	Percs slowly.
45 Havre	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Too arid, erodes easily.
46 Glendive	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding, excess salt.	Soil blowing	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
47 Korchea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
52B Belfield	Moderate: seepage, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Percs slowly	Excess sodium, percs slowly.
55 Wanagan	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Favorable	Favorable.
55B Wanagan	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Favorable	Favorable.
57C*:						
Moreau	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Wayden	Severe: depth to rock.	Severe: thin layer.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Absher	Moderate: slope.	Severe: excess sodium, excess salt.	Deep to water	Droughty, percs slowly.	Erodes easily, percs slowly.	Excess salt, excess sodium.
72 Parshall	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
76B Regent	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
80B Absher	Moderate: slope.	Severe: excess sodium, excess salt.	Deep to water	Droughty, percs slowly.	Erodes easily, percs slowly.	Excess salt, excess sodium.
81F*:						
Cabbart	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Rock outcrop.						
83F*:						
Badland.						
Cherry	Severe: slope.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
84 Lawther	Slight	Moderate: hard to pack.	Deep to water	Percs slowly	Percs slowly	Excess salt, percs slowly.
84B Lawther	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope.	Percs slowly	Excess salt, percs slowly.
88 Sen	Moderate: seepage, depth to rock.	Moderate: thin layer, piping.	Deep to water	Depth to rock	Depth to rock, erodes easily.	Erodes easily, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
88B---------------- Sen	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
89---------------- Shambo	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
89B---------------- Shambo	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Favorable------	Favorable.
97B, 97C---------- Vebar	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
99C*:						
Beisigl----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Depth to rock, too sandy.	Droughty, depth to rock.
Flasher----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Depth to rock, soil blowing.	Droughty, depth to rock.
Vebar------------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
99D*:						
Beisigl----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
Flasher----------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
109B, 109C-------- Amor	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
114*:						
Grail------------	Slight---------	Moderate: piping, hard to pack, excess salt.	Deep to water	Droughty, percs slowly, excess salt.	Percs slowly---	Excess salt, droughty, percs slowly.
Grassna----------	Moderate: seepage.	Severe: piping.	Deep to water	Droughty, excess salt.	Favorable------	Excess salt, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
3---------------- Havre	0-6	Silt loam--------	CL-ML	A-4	0-15	100	100	85-95	60-75	20-30	5-10
	6-60	Stratified sandy loam to silty clay loam.	CL-ML, ML	A-4	0	100	100	70-95	50-75	15-25	NP-10
4---------------- Grassna	0-17	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-100	20-45	3-25
	17-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-100	25-45	3-23
6---------------- Grassna Variant	0-16	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	20-45	3-25
	16-48	Silt loam, loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	20-45	3-25
	48-60	Silt loam, silty clay loam, silty clay.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	20-45	3-25
9C*, 9D*: Cabba-----------	0-6	Silt loam--------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	6-15	Loam, silt loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Chama-----------	0-4	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-20
	4-25	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-100	30-50	5-25
	25-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
10F*: Cabbart---------	0-4	Silt loam--------	CL-ML	A-4	0	90-100	85-100	75-95	55-80	25-30	5-10
	4-14	Loam, silt loam	CL, CL-ML	A-4, A-6	0	90-100	85-100	75-95	60-85	25-35	5-15
	14-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Badland.											
11F*: Brandenburg-----	0-14	Channery loam, very channery loam.	CL-ML, GM-GC, CL, SM-SC	A-2, A-4, A-6	0-5	60-100	40-80	35-75	30-65	20-35	5-15
	14-60	Fragmental material.	GP	A-1	80-85	15-25	5-10	0-5	0	---	NP
Cabbart---------	0-4	Silt loam--------	CL-ML	A-4	0	90-100	85-100	75-95	55-80	25-30	5-10
	4-14	Loam, silt loam	CL, CL-ML	A-4, A-6	0	90-100	85-100	75-95	60-85	25-35	5-15
	14-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
12--------------- Hanly	0-3	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	100	70-85	40-55	<25	NP-5
	3-60	Stratified silty clay loam to sand.	SM, SP-SM	A-2, A-3	0	100	100	50-85	5-25	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
14F*:											
Baahish----------	0-5	Loam--------------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-80	25-40	5-15
	5-8	Loam, fine sandy loam, gravelly loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-5	80-100	75-100	65-100	30-75	25-35	5-15
	8-60	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, SM, GP-GM, SP-SM	A-1, A-2	10-40	40-65	25-55	15-45	10-30	<30	NP-5
Cabbart----------	0-5	Loam--------------	CL-ML	A-4	0	90-100	85-100	75-95	55-80	25-30	5-10
	5-14	Loam, silt loam	CL, CL-ML	A-4, A-6	0	90-100	85-100	75-95	60-85	25-35	5-15
	14-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
19F*:											
Cabbart----------	0-4	Silt loam---------	CL-ML	A-4	0	90-100	85-100	75-95	55-80	25-30	5-10
	4-14	Loam, silt loam	CL, CL-ML	A-4, A-6	0	90-100	85-100	75-95	60-85	25-35	5-15
	14-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cherry-----------	0-4	Silt loam---------	CL	A-6	0	100	100	85-100	60-90	25-35	10-20
	4-26	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-45	10-30
	26-60	Loam, silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
20, 20B---------- Chama	0-4	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-20
	4-25	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-50	5-25
	25-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
21C*:											
Chama------------	0-4	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-20
	4-25	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-50	5-25
	25-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba------------	0-6	Silt loam---------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	6-15	Loam, silt loam	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
24B, 24C--------- Cherry	0-4	Silt loam---------	CL	A-6	0	100	100	85-100	60-90	25-35	10-20
	4-26	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-45	10-30
	26-60	Loam, silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
26--------------- Dimmick	0-30	Silty clay--------	CH, CL, ML	A-7	0	100	100	90-100	75-95	40-60	15-35
	30-41	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	75-95	45-70	20-45
	41-60	Silty clay loam, silt loam, loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	20-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
35F---------------- Flasher	0-6	Loamy sand-------	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	6-11	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	11-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
37, 37B---------- Golva	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-85	25-40	5-20
	6-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-100	30-50	5-25
41---------------- Grail	0-9	Silty clay loam	CL	A-6, A-7	0	100	95-100	95-100	85-95	30-50	10-30
	9-46	Silty clay, silty clay loam.	CL, CH, ML	A-7, A-6	0	100	95-100	95-100	70-95	35-60	10-35
	46-60	Loam, silty clay loam, clay loam.	CL, CH	A-6, A-7	0	100	95-100	85-100	60-95	30-55	10-30
45---------------- Havre	0-6	Silt loam--------	CL-ML	A-4	0-15	100	100	85-95	60-75	20-30	5-10
	6-60	Stratified sandy loam to silty clay loam.	CL-ML, ML	A-4	0	100	100	70-95	50-75	15-25	NP-10
46---------------- Glendive	0-5	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	100	100	65-85	30-55	20-30	NP-10
	5-15	Loam, silt loam, sandy loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	100	65-95	40-70	15-30	NP-10
	15-60	Stratified loamy fine sand to silt loam.	SM, SM-SC	A-2, A-4	0	95-100	75-100	60-80	25-50	15-25	NP-10
47---------------- Korchea	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	75-95	50-70	15-30	5-15
	6-60	Stratified fine sandy loam to silty clay loam.	SM-SC, CL-ML, CL, SC	A-4, A-6, A-7	0	100	100	70-100	40-95	20-50	5-20
52B--------------- Belfield	0-11	Loam-------------	CL	A-6	0	100	100	85-100	60-90	20-40	10-25
	11-31	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	31-43	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30
	43-60	Fine sandy loam, loam.	ML, CL	A-4, A-6	0	100	100	70-100	30-90	20-40	NP-15
55, 55B---------- Wanagan	0-7	Loam-------------	ML, CL, CL-ML	A-6, A-4	0	100	100	85-95	60-75	25-35	3-13
	7-18	Loam-------------	CL, CL-ML, ML	A-6, A-4	0	85-100	80-95	75-90	50-85	25-40	3-18
	18-60	Very gravelly sandy clay loam, extremely gravelly loam, very gravelly fine sandy loam.	SC, SM, SM-SC, SP-SM	A-1, A-2	0-15	70-85	30-65	25-50	5-25	15-40	NP-15
57C*:											
Moreau-----------	0-5	Silty clay loam	CL, CH	A-7, A-6	0	100	100	90-100	70-95	30-60	15-40
	5-17	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-100	45-75	20-50
	17-27	Silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-100	45-75	20-50
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
57C*:											
Wayden----------	0-5	Silty clay-------	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-30
	5-11	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-30
	11-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Absher----------	0-2	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	75-100	65-90	50-80	20-30	5-10
	2-19	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	75-100	70-100	60-95	40-60	20-40
	19-60	Clay loam, clay, silty clay loam.	CL, CH	A-7	0	95-100	75-100	70-100	60-95	40-55	20-35
72--------------- Parshall	0-10	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	10-60	Fine sandy loam, sandy loam, loamy fine sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP
76B-------------- Regent	0-5	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	5-33	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
80B-------------- Absher	0-2	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	75-100	65-90	50-80	20-30	5-10
	2-19	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	75-100	70-100	60-95	40-60	20-40
	19-60	Clay loam, clay, silty clay loam.	CL, CH	A-7	0	95-100	75-100	70-100	60-95	40-55	20-35
81F*:											
Cabbart---------	0-4	Silt loam--------	CL-ML	A-4	0	90-100	85-100	75-95	55-80	25-30	5-10
	4-14	Loam, silt loam	CL, CL-ML	A-4, A-6	0	90-100	85-100	75-95	60-85	25-35	5-15
	14-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
83F*: Badland.											
Cherry----------	0-4	Silt loam--------	CL	A-6	0	100	100	85-100	60-90	25-35	10-20
	4-26	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-45	10-30
	26-60	Loam, silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
84, 84B---------- Lawther	0-5	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	75-100	35-50	15-30
	5-25	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	75-100	35-70	15-40
	25-60	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	75-100	35-70	15-40
88, 88B---------- Sen	0-6	Silt loam--------	CL	A-6	0	100	100	85-100	60-90	25-35	10-20
	6-38	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	85-100	60-95	25-45	10-30
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
89, 89B---------- Shambo	0-5	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	3-13
	5-15	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
	15-42	Stratified loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
	42-60	Gravelly sandy loam, gravelly loam.	SM, SM-SC, SC	A-2, A-4	0	85-100	80-90	60-70	30-40	15-40	NP-15
97B, 97C--------- Vebar	0-11	Fine sandy loam	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	11-38	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
99C*:											
Beisigl---------	0-9	Loamy sand-------	SM, SM-SC	A-2, A-4	0	95-100	85-100	75-95	20-40	<20	NP-5
	9-34	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	95-100	85-100	50-100	15-35	---	NP
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Flasher---------	0-6	Loamy sand-------	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	6-11	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	11-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Vebar-----------	0-11	Sandy loam-------	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	11-38	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
99D*:											
Beisigl---------	0-9	Loamy sand-------	SM, SM-SC	A-2, A-4	0	95-100	85-100	75-95	20-40	<20	NP-5
	9-34	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	95-100	85-100	50-100	15-35	---	NP
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Flasher---------	0-6	Loamy sand-------	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	6-11	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	11-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
109B, 109C------- Amor	0-6	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	65-85	25-40	3-18
	6-34	Clay loam, loam, silt loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	75-100	50-95	20-45	2-25
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
114*:											
Grail-----------	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	10-30
	8-41	Silty clay, silty clay loam.	CL, CH, ML	A-7, A-6	0	100	100	95-100	70-95	35-60	10-35
	41-60	Loam, clay loam, sandy clay loam.	CL, CH, ML	A-6, A-7	0	100	100	85-100	60-95	30-55	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
114*:											
Grassna----------	0-9	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	20-45	3-25
	9-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	25-45	3-25

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
3----------------	0-6	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.37	5	4L
Havre	6-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low--------	0.28		
4----------------	0-17	0.6-2.0	0.22-0.24	6.1-7.8	<2	Moderate	0.32	5	6
Grassna	17-60	0.6-2.0	0.16-0.22	6.6-8.4	<2	Moderate	0.32		
6----------------	0-16	0.6-2.0	0.10-0.12	7.4-8.4	>16	Moderate	0.32	5	6
Grassna Variant	16-48	0.6-2.0	0.09-0.12	7.4-8.4	>16	Moderate	0.32		
	48-60	0.6-2.0	0.08-0.11	7.4-8.4	8-16	Moderate	0.32		
9C*, 9D*:									
Cabba-----------	0-6	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	2	4L
	6-15	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	15-60	---	---	---	---	----------	----		
Chama-----------	0-4	0.6-2.0	0.20-0.24	6.6-8.4	<2	Moderate	0.32	4	4L
	4-25	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	0.43		
	25-60	---	---	---	---	----------	----		
10F*:									
Cabbart---------	0-4	0.6-2.0	0.17-0.21	7.4-8.4	<4	Low--------	0.37	2	4L
	4-14	0.6-2.0	0.15-0.19	7.4-8.4	2-8	Moderate	0.37		
	14-60	---	---	---	---	----------	----		
Badland.									
11F*:									
Brandenburg-----	0-14	0.6-2.0	0.18-0.20	6.6-7.8	<2	Low--------	0.24	2	8
	14-60	>20	0.01-0.03	6.6-8.4	<2	Low--------	0.10		
Cabbart---------	0-4	0.6-2.0	0.17-0.21	7.4-8.4	<4	Low--------	0.37	2	4L
	4-14	0.6-2.0	0.15-0.19	7.4-8.4	2-8	Moderate	0.37		
	14-60	---	---	---	---	----------	----		
12---------------	0-3	2.0-6.0	0.13-0.15	6.6-8.4	<2	Low--------	0.17	5	3
Hanly	3-60	6.0-20	0.05-0.14	6.6-8.4	<2	Low--------	0.17		
14F*:									
Baahish---------	0-5	0.6-2.0	0.18-0.20	6.1-7.3	<2	Moderate	0.28	2	3
	5-8	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.28		
	8-60	6.0-20	0.03-0.05	7.4-8.4	<2	Low--------	0.10		
Cabbart---------	0-5	0.6-2.0	0.17-0.21	7.4-8.4	<4	Low--------	0.37	2	4L
	5-14	0.6-2.0	0.15-0.19	7.4-8.4	2-8	Moderate	0.37		
	14-60	---	---	---	---	----------	----		
19F*:									
Cabbart---------	0-4	0.6-2.0	0.17-0.21	7.4-8.4	<4	Low--------	0.37	2	4L
	4-14	0.6-2.0	0.15-0.19	7.4-8.4	2-8	Moderate	0.37		
	14-60	---	---	---	---	----------	----		
Cherry----------	0-4	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.37	5	6
	4-26	0.2-0.6	0.16-0.22	7.9-9.0	<2	Moderate	0.37		
	26-60	0.2-0.6	0.13-0.22	7.9-9.0	<8	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
20, 20B---------- Chama	0-4	0.6-2.0	0.20-0.24	6.6-8.4	<2	Moderate	0.32	4	4L
	4-25	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	0.43		
	25-60	---	---	---	---	----------	----		
21C*: Chama-----------	0-4	0.6-2.0	0.20-0.24	6.6-8.4	<2	Moderate	0.32	4	4L
	4-25	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	0.43		
	25-60	---	---	---	---	----------	----		
Cabba-----------	0-6	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	2	4L
	6-15	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	15-60	---	---	---	---	----------	----		
24B, 24C--------- Cherry	0-4	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.37	5	6
	4-26	0.2-0.6	0.16-0.22	7.9-9.0	<2	Moderate	0.37		
	26-60	0.2-0.6	0.13-0.22	7.9-9.0	<8	Moderate	0.37		
26--------------- Dimmick	0-30	<0.2	0.14-0.23	6.1-8.4	<2	High------	0.28	5	4
	30-41	<0.06	0.13-0.20	7.4-8.4	<2	High------	0.28		
	41-60	0.06-2.0	0.16-0.22	7.4-8.4	<2	Moderate	0.28		
35F-------------- Flasher	0-6	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17	2	2
	6-11	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17		
	11-60	---	---	---	---	----------	----		
37, 37B---------- Golva	0-6	0.6-2.0	0.20-0.23	6.6-7.8	<2	Moderate	0.32	5	6
	6-60	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.43		
41--------------- Grail	0-9	0.2-0.6	0.20-0.23	6.1-8.4	<2	Moderate	0.32	5	7
	9-46	0.2-0.6	0.14-0.17	6.6-8.4	<2	High------	0.32		
	46-60	0.2-0.6	0.13-0.22	7.4-8.4	<4	Moderate	0.32		
45--------------- Havre	0-6	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low-------	0.37	5	4L
	6-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low-------	0.28		
46--------------- Glendive	0-5	2.0-6.0	0.10-0.13	6.6-9.0	<4	Low-------	0.20	5	3
	5-15	2.0-6.0	0.15-0.19	7.4-9.0	<4	Low-------	0.32		
	15-60	2.0-6.0	0.10-0.13	7.4-9.0	2-8	Low-------	0.20		
47--------------- Korchea	0-6	0.6-2.0	0.17-0.21	6.6-8.4	<2	Low-------	0.28	5	5
	6-60	0.6-2.0	0.16-0.18	7.4-9.0	<2	Moderate	0.28		
52B-------------- Belfield	0-11	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.32	3	6
	11-31	0.06-0.2	0.14-0.18	6.6-7.8	<2	High------	0.32		
	31-43	0.06-0.2	0.13-0.16	7.9-9.0	4-16	High------	0.32		
	43-60	0.6-6.0	0.10-0.12	7.9-9.0	4-16	Moderate	0.32		
55, 55B---------- Wanagan	0-7	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low-------	0.28	5	6
	7-18	0.6-2.0	0.17-0.19	7.4-8.4	<2	Moderate	0.28		
	18-60	0.6-2.0	0.06-0.12	7.4-8.4	<2	Low-------	0.10		
57C*: Moreau----------	0-5	0.2-0.6	0.18-0.23	7.4-9.0	<2	High------	0.32	4	4L
	5-17	0.06-0.2	0.14-0.17	7.4-9.0	<4	High------	0.32		
	17-27	0.06-0.2	0.13-0.15	7.4-9.0	2-16	High------	0.32		
	27-60	---	---	---	---	----------	----		
Wayden----------	0-5	0.06-0.2	0.15-0.18	7.4-9.0	<2	High------	0.32	2	4
	5-11	0.06-0.2	0.14-0.19	7.4-9.0	<8	High------	0.32		
	11-60	---	---	---	---	----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
57C*:									
Absher----------	0-2	0.2-0.6	0.12-0.16	6.6-8.4	4-8	Low-------	0.32	3	5
	2-19	<0.06	0.08-0.10	6.6-8.4	8-16	High------	0.32		
	19-60	<0.06	0.05-0.07	7.9-9.0	>16	High------	0.32		
72--------------- Parshall	0-10	2.0-6.0	0.16-0.18	5.6-8.4	<2	Low-------	0.20	5	3
	10-60	2.0-6.0	0.12-0.17	5.6-8.4	<2	Low-------	0.20		
76B-------------- Regent	0-5	0.06-0.2	0.17-0.20	6.1-7.8	<2	High------	0.32	4	7
	5-33	0.06-0.2	0.17-0.20	7.4-9.0	<8	High------	0.32		
	33-60	---	---	---	---	----------	----		
80B-------------- Absher	0-2	0.2-0.6	0.12-0.16	6.6-8.4	4-8	Low-------	0.32	3	5
	2-19	<0.06	0.08-0.10	6.6-8.4	8-16	High------	0.32		
	19-60	<0.06	0.05-0.07	7.9-9.0	>16	High------	0.32		
81F*:									
Cabbart---------	0-4	0.6-2.0	0.17-0.21	7.4-8.4	<4	Low-------	0.37	2	4L
	4-14	0.6-2.0	0.15-0.19	7.4-8.4	2-8	Moderate	0.37		
	14-60	---	---	---	---	----------	----		
Rock outcrop.									
83F*:									
Badland.									
Cherry----------	0-4	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.37	5	6
	4-26	0.2-0.6	0.16-0.22	7.9-9.0	<2	Moderate	0.37		
	26-60	0.2-0.6	0.13-0.22	7.9-9.0	<8	Moderate	0.37		
84, 84B---------- Lawther	0-5	0.06-0.2	0.14-0.17	6.6-8.4	<2	High------	0.32	5	7
	5-25	0.06-0.2	0.14-0.17	7.4-9.0	<4	High------	0.32		
	25-60	0.06-0.2	0.14-0.17	7.9-9.0	4-12	High------	0.32		
88, 88B---------- Sen	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.32	4	6
	6-38	0.6-2.0	0.16-0.22	6.6-9.0	<2	Moderate	0.43		
	38-60	---	---	---	---	----------	----		
89, 89B---------- Shambo	0-5	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low-------	0.28	5	6
	5-15	0.6-2.0	0.17-0.19	6.6-8.4	<2	Moderate	0.28		
	15-42	0.6-2.0	0.17-0.19	7.4-9.0	<2	Moderate	0.28		
	42-60	0.6-6.0	0.11-0.13	7.4-9.0	<2	Low-------	0.15		
97B, 97C--------- Vebar	0-11	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low-------	0.20	4	3
	11-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20		
	38-60	---	---	---	---	----------	----		
99C*:									
Beisigl---------	0-9	6.0-20	0.11-0.13	6.6-8.4	<2	Low-------	0.17	4	2
	9-34	6.0-20	0.05-0.10	7.4-8.4	<2	Low-------	0.17		
	34-60	---	---	---	---	----------	----		
Flasher---------	0-6	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17	2	2
	6-11	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17		
	11-60	---	---	---	---	----------	----		
Vebar-----------	0-11	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low-------	0.20	4	3
	11-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20		
	38-60	---	---	---	---	----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
99D*:									
Beisigl----------	0-9	6.0-20	0.11-0.13	6.6-8.4	<2	Low--------	0.17	4	2
	9-34	6.0-20	0.05-0.10	7.4-8.4	<2	Low--------	0.17		
	34-60	---	---	---	---	-----------	----		
Flasher----------	0-6	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17	2	2
	6-11	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17		
	11-60	---	---	---	---	-----------	----		
109B, 109C-------- Amor	0-6	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.28	4	6
	6-34	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	34-60	---	---	---	---	-----------	----		
114*:									
Grail------------	0-8	0.2-0.6	0.10-0.12	6.1-8.4	8-16	Moderate	0.32	5	7
	8-41	0.2-0.2	0.07-0.09	6.6-8.4	8-16	High-------	0.32		
	41-60	0.2-0.2	0.06-0.11	7.4-8.4	8-16	Moderate	0.32		
Grassna----------	0-9	0.6-2.0	0.11-0.12	6.1-7.8	8-16	Moderate	0.32	5	6
	9-60	0.6-2.0	0.08-0.11	6.6-8.4	8-16	Moderate	0.32		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
3----------------- Havre	B	Occasional	Very brief to brief.	Mar-May	>6.0	---	---	>60	---	Moderate	High-----	Low.
4----------------- Grassna	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
6----------------- Grassna Variant	B	None---------	---	---	0-2.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	High.
9C*, 9D*:												
Cabba------------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
Chama------------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
10F*:												
Cabbart----------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	---	---
Badland.												
11F*:												
Brandenburg------	A	None---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.
Cabbart----------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	---	---
12----------------- Hanly	A	Occasional	Brief-----	Mar-Jun	>6.0	---	---	>60	---	Low------	Moderate	Low.
14F*:												
Baahish----------	B	None---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Cabbart----------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	---	---
19F*:												
Cabbart----------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	---	---

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
19F*:												
Cherry	C	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
20, 20B Chama	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Low.
21C*:												
Chama	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Low.
Cabba	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.
24B, 24C Cherry	C	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
26 Dimmick	D	None	---	---	+1-2.0	Apparent	Apr-Jul	>60	---	Moderate	High	Low.
35F Flasher	D	None	---	---	>6.0	---	---	7-20	Soft	Low	Moderate	Low.
37, 37B Golva	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
41 Grail	C	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
45 Havre	B	Occasional	Very brief to brief.	Mar-May	>6.0	---	---	>60	---	Moderate	High	Low.
46 Glendive	B	Occasional	Brief	Apr-Jun	>6.0	---	---	>60	---	Low	High	Low.
47 Korchea	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
52B Belfield	C	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
55, 55B----------- Wanagan	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
57C*:												
Moreau-----------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
Wayden-----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low-------	High-----	Moderate.
Absher-----------	D	None--------	---	---	>6.0	---	---	>60	---	Low-------	High-----	Moderate.
72--------------- Parshall	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
76B-------------- Regent	C	None--------	---	---	>6.0	---	---	20-40	Soft	Low-------	High-----	Moderate.
80B-------------- Absher	D	None--------	---	---	>6.0	---	---	>60	---	Low-------	High-----	Moderate.
81F*:												
Cabbart----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	---	---
Rock outcrop.												
83F*:												
Badland.												
Cherry-----------	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
84, 84B---------- Lawther	D	None--------	---	---	>6.0	---	---	>60	---	Low-------	High-----	High.
88, 88B---------- Sen	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Moderate.
89, 89B---------- Shambo	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
97B, 97C---------- Vebar	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate	Low.
99C*:												
Beisigl----------	A	None---------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate	Low.
Flasher----------	D	None---------	---	---	>6.0	---	---	7-20	Soft	Low------	Moderate	Low.
Vebar------------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate	Low.
99D*:												
Beisigl----------	A	None---------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate	Low.
Flasher----------	D	None---------	---	---	>6.0	---	---	7-20	Soft	Low------	Moderate	Low.
109B, 109C-------- Amor	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Moderate.
114*:												
Grail------------	C	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Moderate.
Grassna----------	B	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

(Dashes indicate data were not available. LL means liquid limit; PI, plasticity index; MD, maximum dry density; and OM, optimum moisture)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								LL	PI	Moisture density	
			Percentage passing sieve--					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			MD	OM
											Pct		Lb/ft3	Pct
Absher loam: (S83ND-033-168)														
Btyz---- 6 to 19	A-7-6(16)	CL	100	100	100	100	93	--	49	--	46	28	118	13
Bk1----- 27 to 39	A-7-6(15)	CL	100	100	100	100	84	--	38	--	46	26	120	12
Cabba silt loam: (S83ND-033-182)														
C------- 10 to 17	A-4(8)	ML	100	100	100	100	96	--	23	--	34	10	115	14
Chama silt loam: (S83ND-033-163)														
Bw------ 5 to 10	A-7-6(13)	CL	100	100	100	100	98	--	51	--	44	19	111	16
Bk2----- 15 to 26	A-6(10)	CL	100	100	100	100	100	--	51	--	37	15	121	12
Cherry silt loam: (S82ND-033-138)														
Bw2----- 10 to 21	A-6(10)	CL	100	100	100	99	92	--	32	--	34	14	118	13
C1------ 26 to 44	A-6(10)	CL	100	100	100	99	94	--	42	--	35	16	118	13
Dimmick silty clay, loamy substratum: (S83ND-033-177)														
A------- 6 to 30	A-7-6(14)	ML	100	100	100	100	98	--	66	--	49	20	106	17
Cg------ 41 to 51	A-4(8)	CL	100	100	100	98	95	--	49	--	30	10	121	12
Golva silt loam: (S82ND-033-142)														
Bw1----- 6 to 12	A-6(10)	CL	100	100	100	100	91	--	23	--	35	15	115	14
C------- 32 to 60	A-6(10)	CL	100	100	100	100	98	--	46	--	35	16	121	12
Grassna silt loam: (S83ND-033-181)														
A------- 6 to 19	A-7-6(10)	ML	100	100	100	100	97	--	39	--	40	14	108	17
Bk2----- 38 to 54	A-6(11)	CL	100	100	100	100	97	--	47	--	39	17	114	15

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								LL	PI	Moisture density	
			Percentage passing sieve--					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			MD	OM
											Pct		Lb/ft3	Pct
Korchea silt loam: (S82ND-033-136)														
C2'----- 18 to 34	A-4(8)	CL	100	100	100	100	86	--	21	--	30	9	118	13
C3''---- 40 to 60	A-6(9)	CL	100	100	100	100	87	--	21	--	32	12	116	14
Moreau silty clay loam: (S83ND-033-179)														
Bw2----- 8 to 12	A-7-6(13)	CL	100	100	100	100	92	--	42	--	46	20	112	15
Bk------ 12 to 20	A-7-6(16)	CL	100	100	100	100	96	--	50	--	50	26	114	14
Wanagan loam: (S82ND-033-140)														
Bw------ 7 to 14	A-6(4)	CL	92	94	86	81	54	--	11	--	29	11	120	13
2C2----- 39 to 50	A-1-b(0)	SM	97	83	63	45	21	--	4	--	23	3	124	11

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

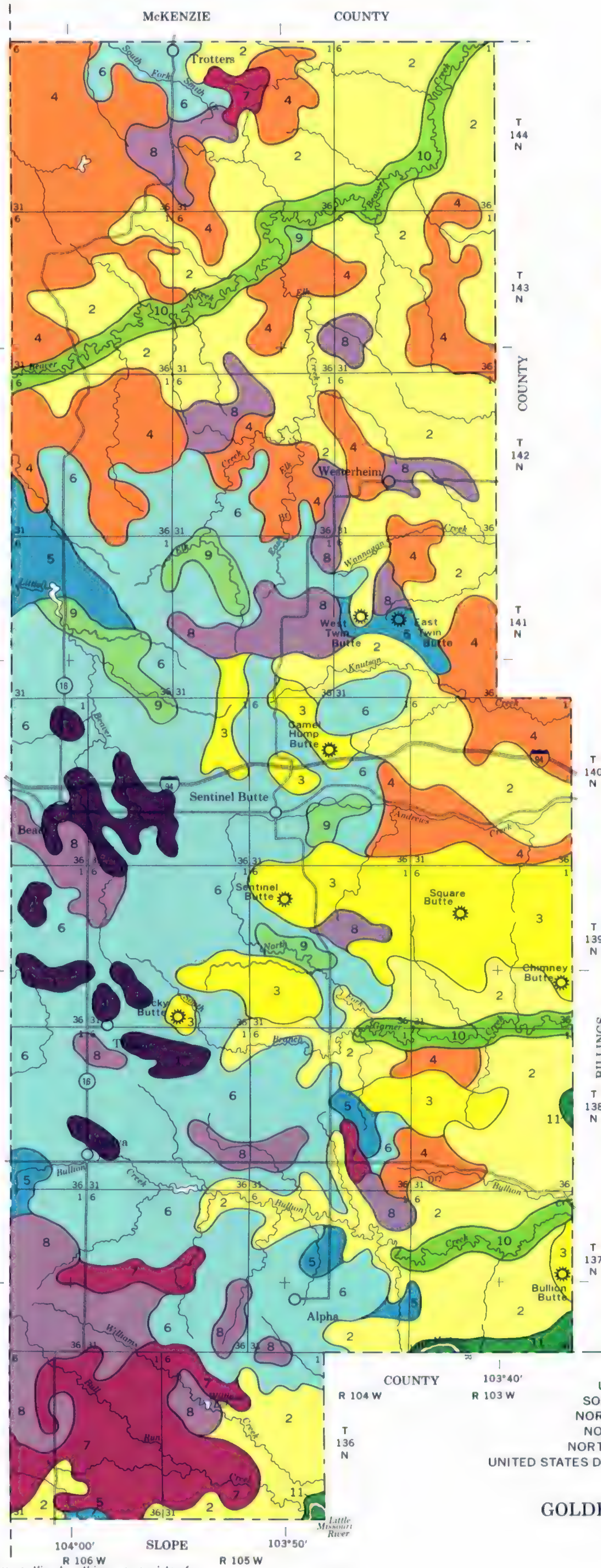
Soil name	Family or higher taxonomic class
Absher	Fine, montmorillonitic Borollic Natrargids
Amor	Fine-loamy, mixed Typic Haploborolls
Baahish	Loamy-skeletal, mixed Entic Haploborolls
Beisigl	Mixed, frigid Typic Ustipsamments
*Belfield	Fine, montmorillonitic Glossic Natriborolls
Brandenburg	Fragmental, mixed, frigid Typic Ustorthents
Cabba	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Cabbart	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents
Chama	Fine-silty, mixed Entic Haploborolls
Cherry	Fine-silty, mixed, frigid Typic Ustochrepts
Dimmick	Fine, montmorillonitic, frigid Typic Haplaquolls
Flasher	Mixed, frigid, shallow Typic Ustipsamments
Glendive	Coarse-loamy, mixed (calcareous), frigid Ustic Torrifluvents
Golva	Fine-silty, mixed Typic Haploborolls
Grail	Fine, montmorillonitic Pachic Argiborolls
Grassna	Fine-silty, mixed Pachic Haploborolls
Grassna Variant	Fine-silty, mixed (calcareous), frigid Typic Haplaquolls
Hanly	Sandy, mixed, frigid Ustic Torrifluvents
Havre	Fine-loamy, mixed (calcareous), frigid Ustic Torrifluvents
Korchea	Fine-loamy, mixed (calcareous), frigid Mollic Ustifluvents
Lawther	Fine, montmorillonitic Vertic Haploborolls
Moreau	Fine, montmorillonitic Typic Haploborolls
Parshall	Coarse-loamy, mixed Pachic Haploborolls
Regent	Fine, montmorillonitic Typic Argiborolls
Sen	Fine-silty, mixed Typic Haploborolls
Shambo	Fine-loamy, mixed Typic Haploborolls
Vebar	Coarse-loamy, mixed Typic Haploborolls
Wanagan	Loamy-skeletal, mixed Typic Haploborolls
Wayden	Clayey, montmorillonitic (calcareous), frigid, shallow Typic Ustorthents

☆ U.S. GOVERNMENT PRINTING OFFICE : 1989 O - 183-536 : QL 3

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND*

DOMINANTLY LEVEL, SALINE, SILTY SOILS ON UPLANDS

1 — Grail-Grassna-Grassna Variant association: Deep, well drained and somewhat poorly drained, moderately fine textured and medium textured, level, saline soils

DOMINANTLY GENTLY SLOPING TO VERY STEEP, SILTY AND LOAMY SOILS ON UPLANDS

2 — Badland-Cabbart-Cherry association: Badland and shallow and deep, well drained, medium textured, gently sloping to very steep soils

3 — Brandenburg-Cabbart association: Deep and shallow, excessively drained and well drained, medium textured, moderately sloping to very steep soils

4 — Cabbart-Cherry association: Shallow and deep, well drained, medium textured, gently sloping to very steep soils

DOMINANTLY NEARLY LEVEL TO STRONGLY SLOPING, SILTY SOILS ON UPLANDS

5 — Cabba-Chama association: Shallow and moderately deep, well drained, medium textured, nearly level to strongly sloping soils

6 — Chama-Golva-Cabba association: Moderately deep, deep, and shallow, well drained, medium textured, nearly level to strongly sloping soils

DOMINANTLY NEARLY LEVEL AND GENTLY SLOPING, ALKALI, LOAMY SOILS ON UPLANDS

7 — Absher-Belfield association: Deep, moderately well drained and well drained, medium textured, nearly level and gently sloping, alkali soils

DOMINANTLY NEARLY LEVEL TO VERY STEEP, SANDY AND LOAMY SOILS ON UPLANDS

8 — Flasher-Vebar-Beisigl association: Shallow and moderately deep, somewhat excessively drained and well drained, coarse textured and moderately coarse textured, nearly level to very steep soils

DOMINANTLY LEVEL TO MODERATELY STEEP, LOAMY AND SILTY SOILS ON FLOOD PLAINS, TERRACES, AND OUTWASH PLAINS

9 — Wanagan-Shambo-Baahish association: Deep, well drained and somewhat excessively drained, medium textured, nearly level to moderately steep soils

10 — Havre-Korchea association: Deep, well drained, medium textured, level and nearly level soils

11 — Hanly-Glendive association: Deep, somewhat excessively drained and well drained, moderately coarse textured, level and nearly level soils

*The texture terms in the descriptive headings refer to the surface layer of the major soils in the associations.

Compiled 1986

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE AND FOREST SERVICE
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION
NORTH DAKOTA COOPERATIVE EXTENSION SERVICE
NORTH DAKOTA STATE SOIL CONSERVATION COMMITTEE
UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT

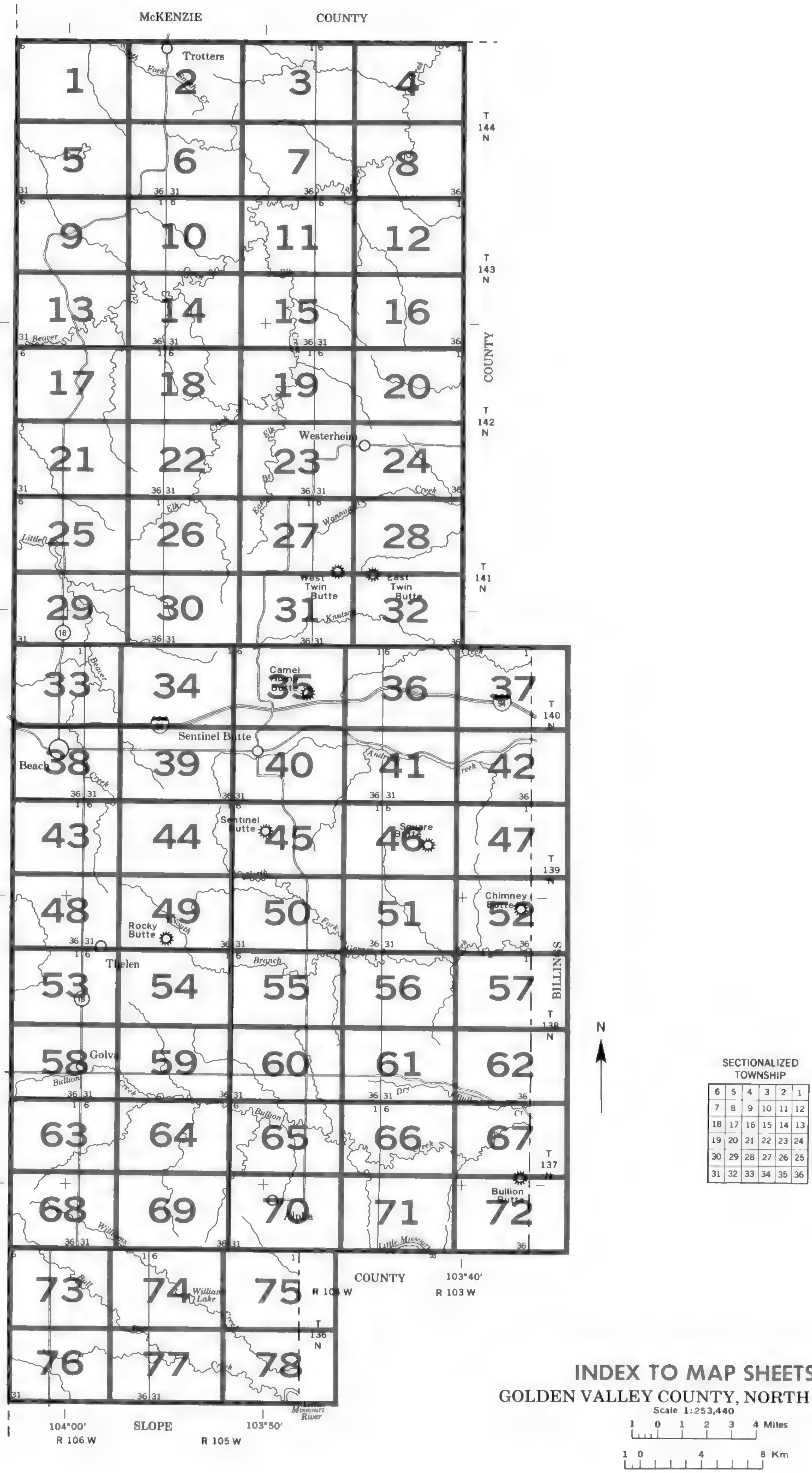
GENERAL SOIL MAP

GOLDEN VALLEY COUNTY, NORTH DAKOTA

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



INDEX TO MAP SHEETS
GOLDEN VALLEY COUNTY, NORTH DAKOTA

SOIL LEGEND

Map symbols consist of a number or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils.

SYMBOL	NAME
3	Havre silt loam, channeled
4	Grassna silt loam, 1 to 3 percent slopes
6	Grassna Variant silt loam
9C	Cabba-Chama silt loams, 3 to 9 percent slopes
9D	Cabba-Chama silt loams, 9 to 15 percent slopes
10F	Cabbart-Badland complex, 15 to 50 percent slopes
11F	Brandenburg-Cabbart complex, 6 to 50 percent slopes
12	Hanly fine sandy loam, 0 to 3 percent slopes
14F	Baahish-Cabbart loams, 6 to 25 percent slopes
19F	Cabbart-Cherry silt loams, 9 to 35 percent slopes
20	Chama silt loam, 1 to 3 percent slopes
20B	Chama silt loam, 3 to 6 percent slopes
21C	Chama-Cabba silt loams, 3 to 9 percent slopes
24B	Cherry silt loam, 3 to 6 percent slopes
24C	Cherry silt loam, 6 to 9 percent slopes
26	Dimmick silty clay, loamy substratum
35F	Flasher loamy sand, 15 to 45 percent slopes
37	Golva silt loam, 1 to 3 percent slopes
37B	Golva silt loam, 3 to 6 percent slopes
41	Grail silty clay loam, 1 to 3 percent slopes
45	Havre silt loam, 0 to 3 percent slopes
46	Glendive fine sandy loam, 0 to 3 percent slopes
47	Korchea silt loam, 0 to 3 percent slopes
52B	Belfield loam, 1 to 6 percent slopes
55	Wanagan loam, 1 to 3 percent slopes
55B	Wanagan loam, 3 to 6 percent slopes
57C	Moreau-Wayden-Absher complex, 3 to 9 percent slopes
72	Parshall fine sandy loam, 0 to 3 percent slopes
76B	Regent silty clay loam, 3 to 6 percent slopes
80B	Absher loam, 1 to 6 percent slopes
81F	Cabbart-Rock outcrop complex, 15 to 120 percent slopes
83F	Badland-Cherry complex, 6 to 75 percent slopes
84	Lawther silty clay loam, 1 to 3 percent slopes
84B	Lawther silty clay loam, 3 to 6 percent slopes
88	Sen silt loam, 1 to 3 percent slopes
88B	Sen silt loam, 3 to 6 percent slopes
89	Shambo loam, 1 to 3 percent slopes
89B	Shambo loam, 3 to 6 percent slopes
97B	Vebar fine sandy loam, 1 to 6 percent slopes
97C	Vebar fine sandy loam, 6 to 9 percent slopes
99C	Beisigl-Flasher-Vebar complex, 3 to 9 percent slopes
99D	Beisigl-Flasher loamy sands, 9 to 15 percent slopes
109B	Amor loam, 3 to 6 percent slopes
109C	Amor loam, 6 to 9 percent slopes
114	Grail-Grassna complex, saline

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Small Airport; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 20B; 4

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown) — S

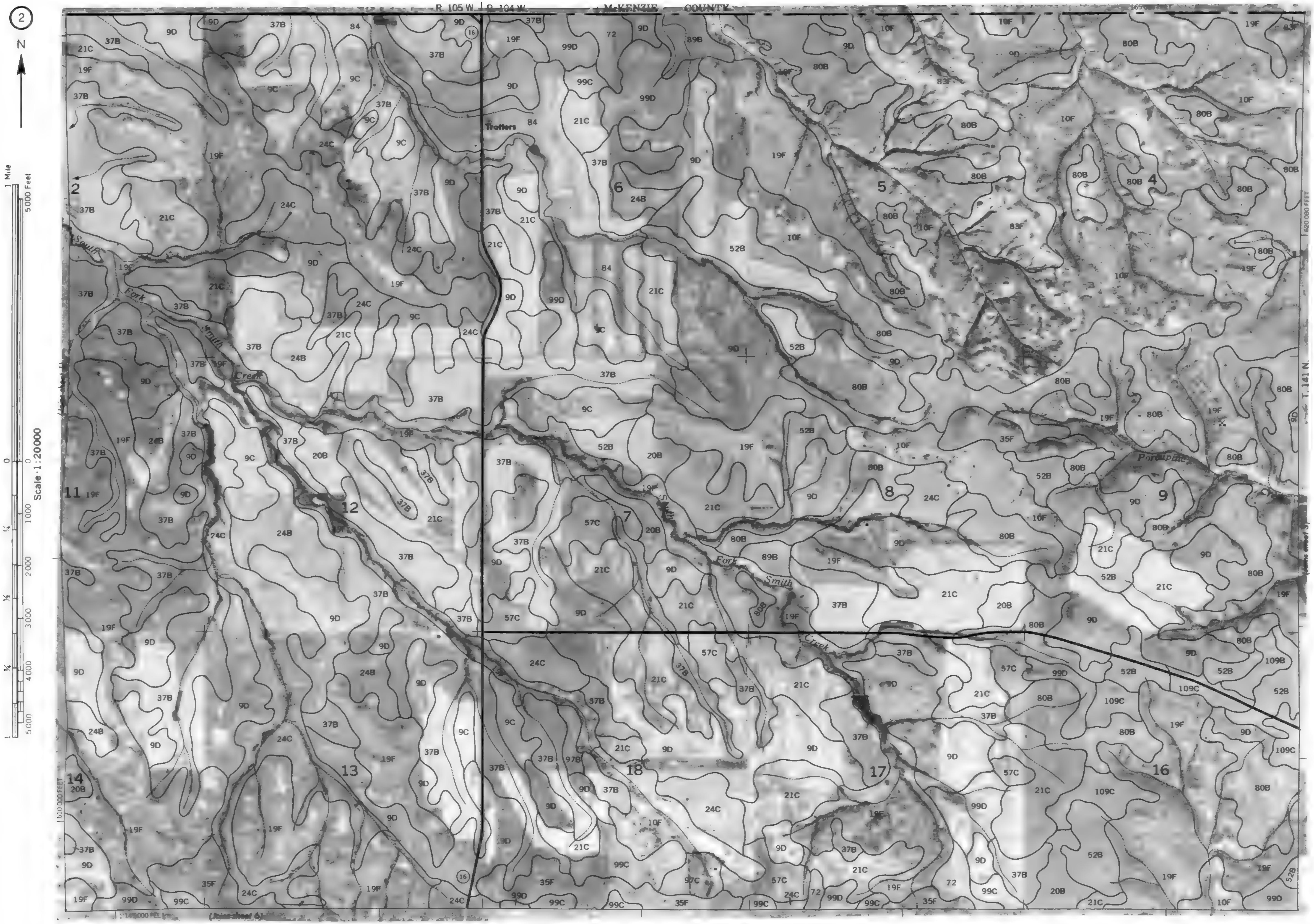
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Porcelanite outcrop
- Clay buttes

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 1

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 1



GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 2

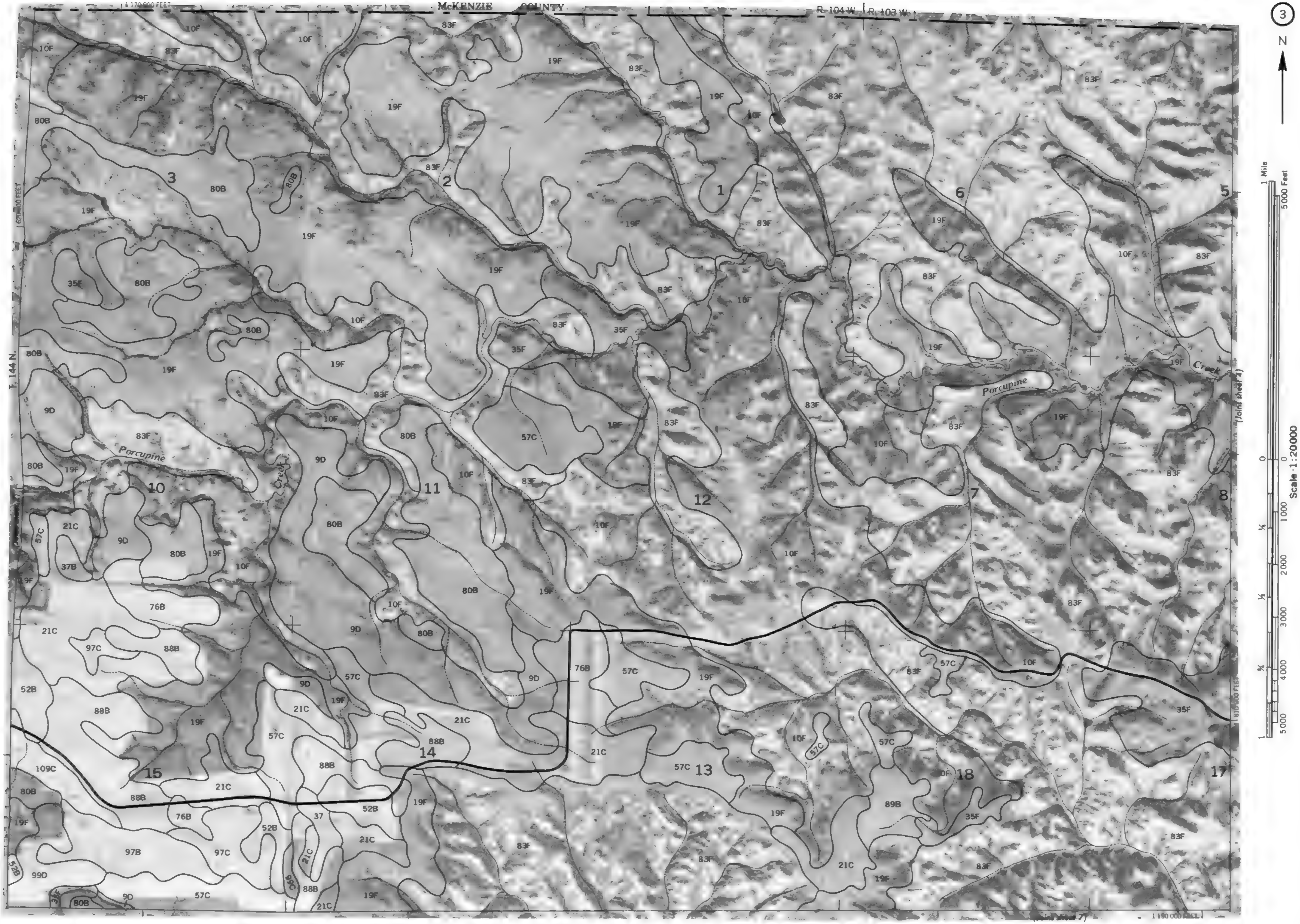
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

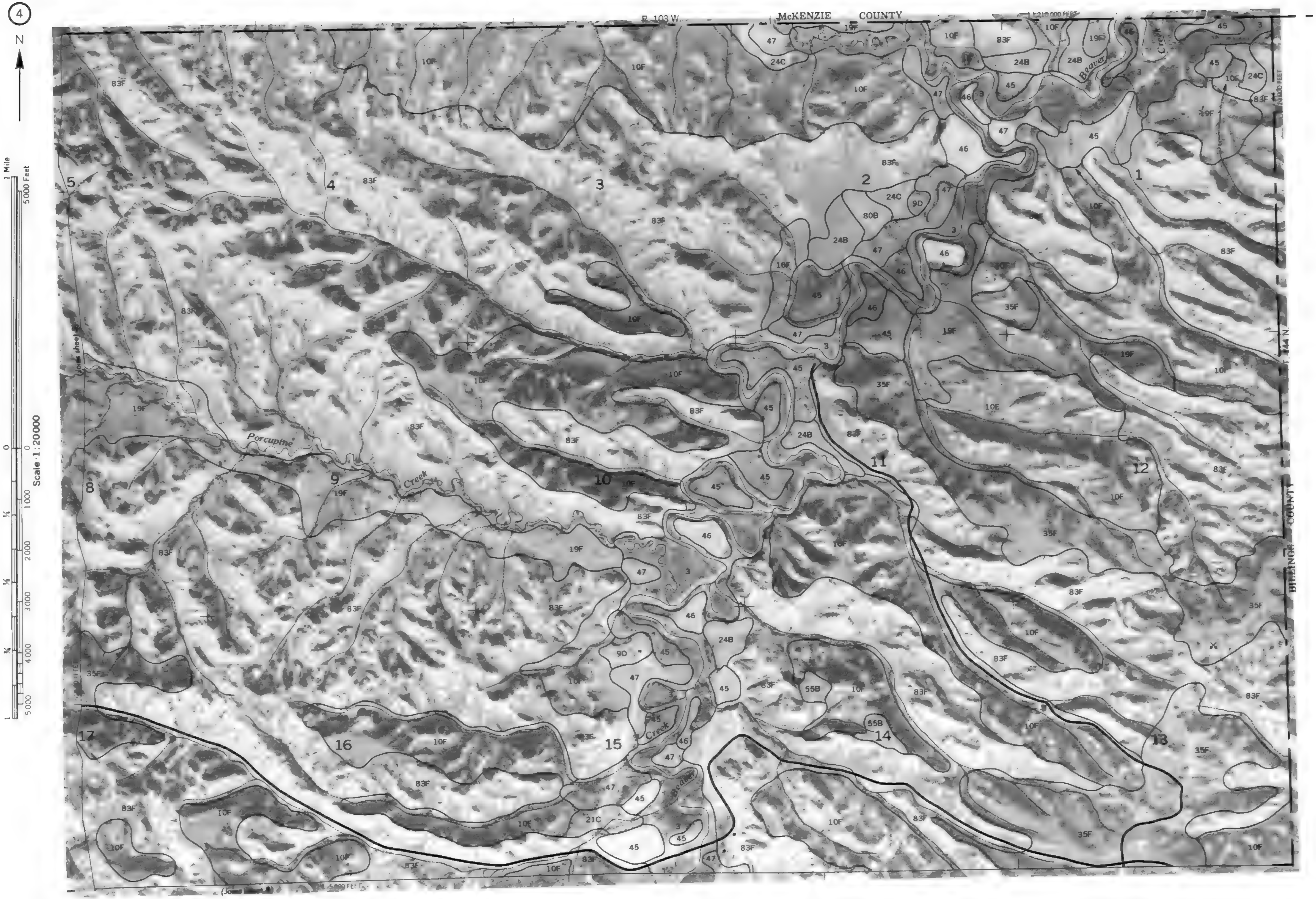
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 2

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 3

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 3

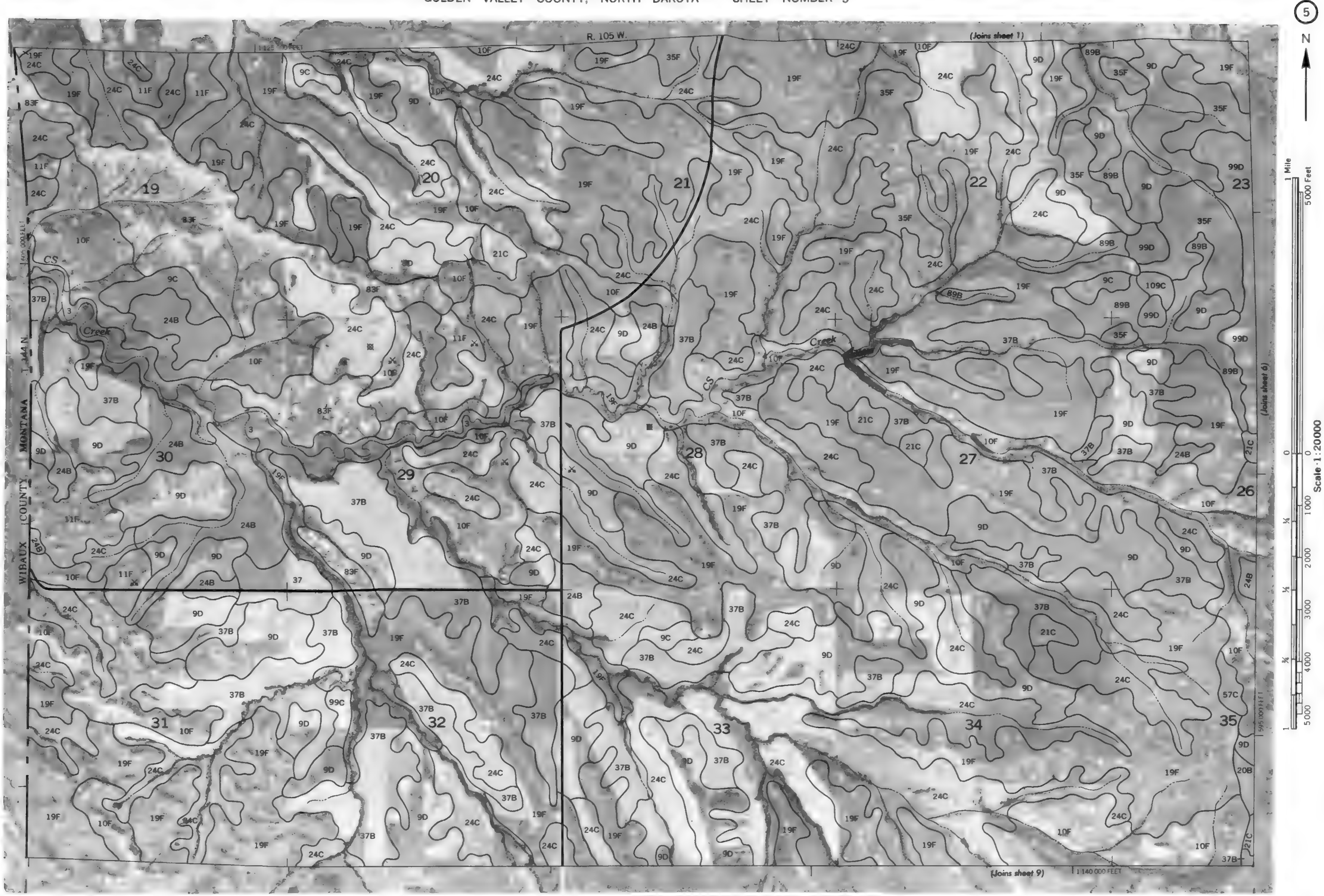




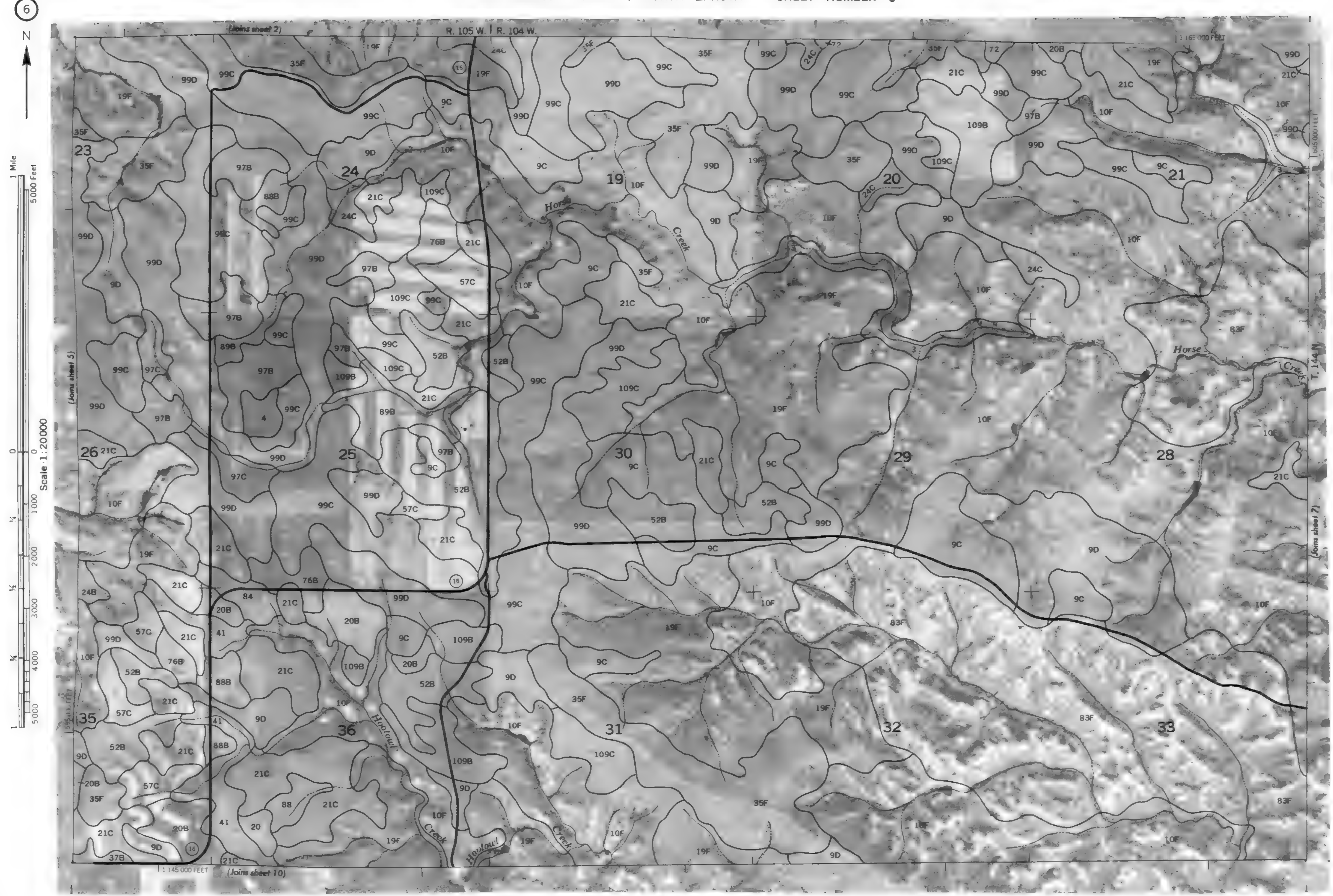
GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 4

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 4



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 6

7

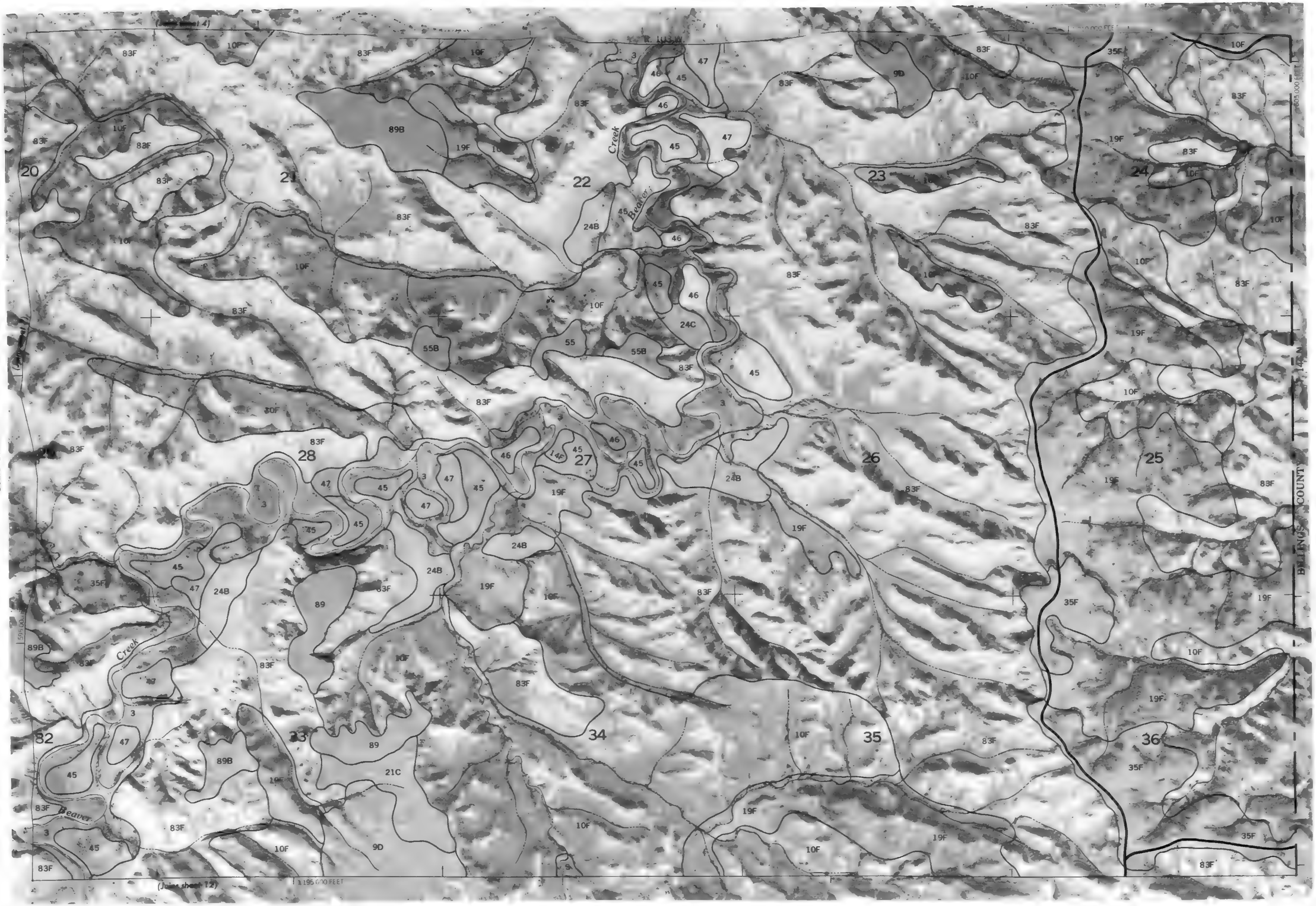
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 7

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

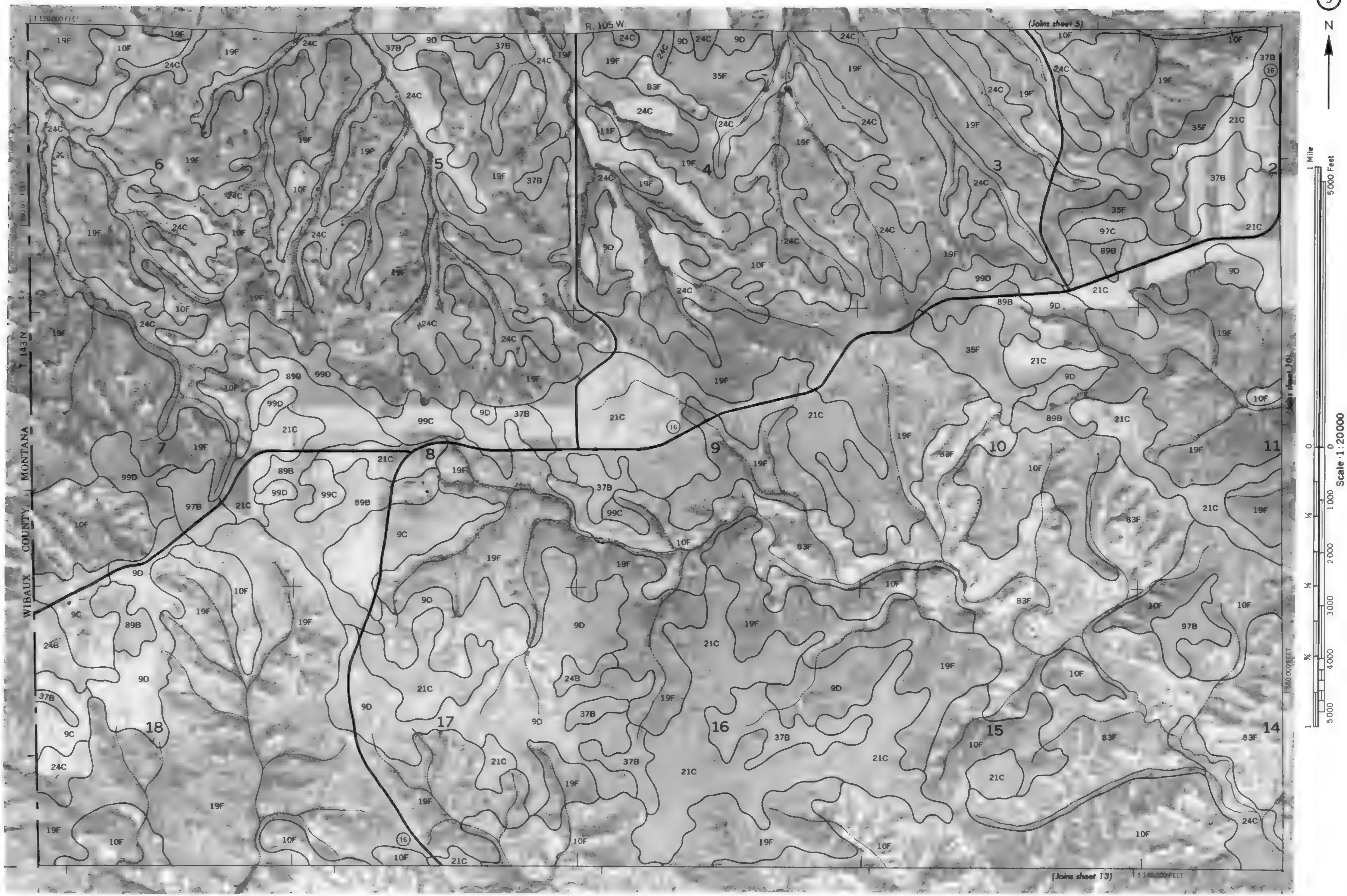
8

N

1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

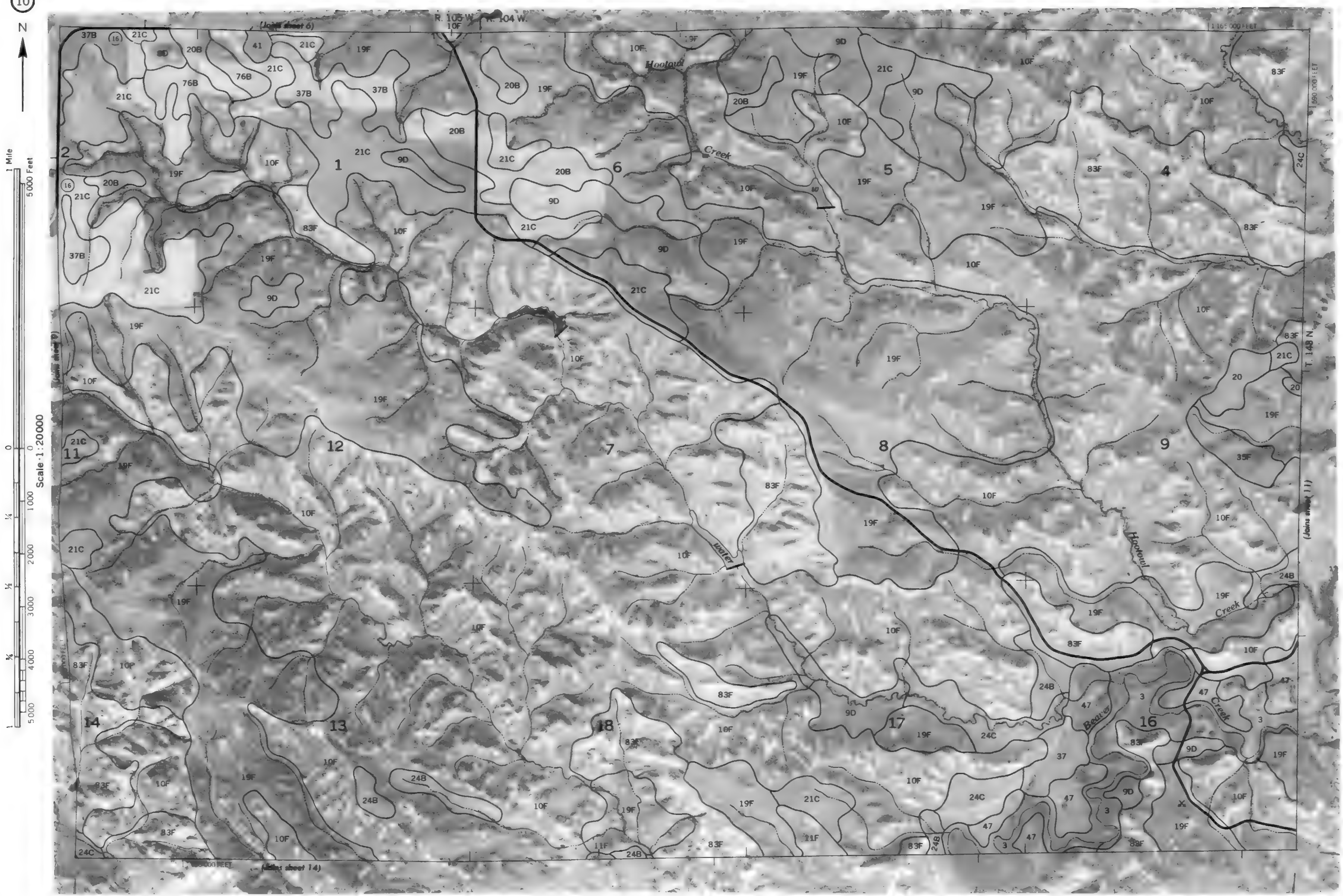


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

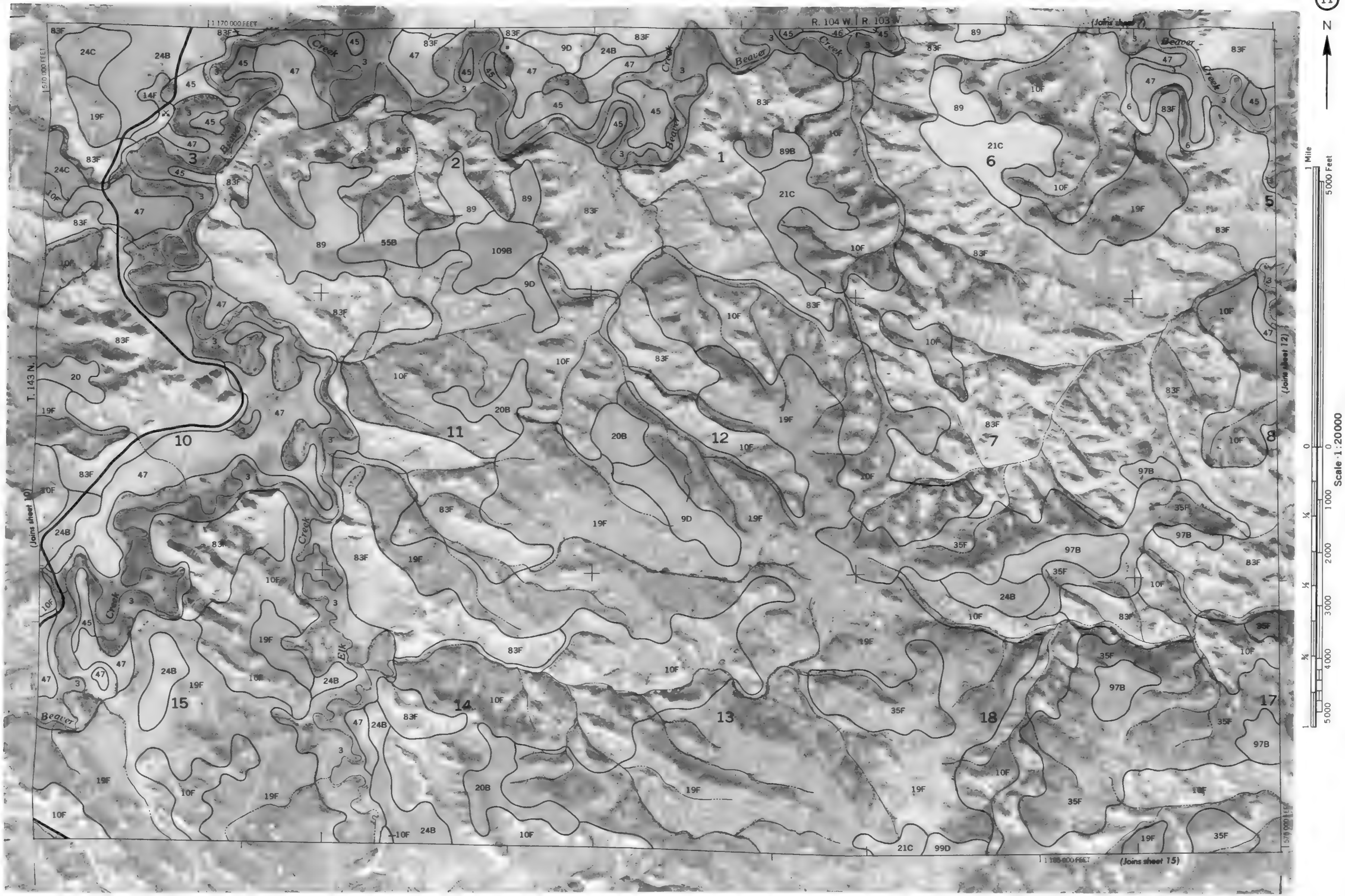


GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 9

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

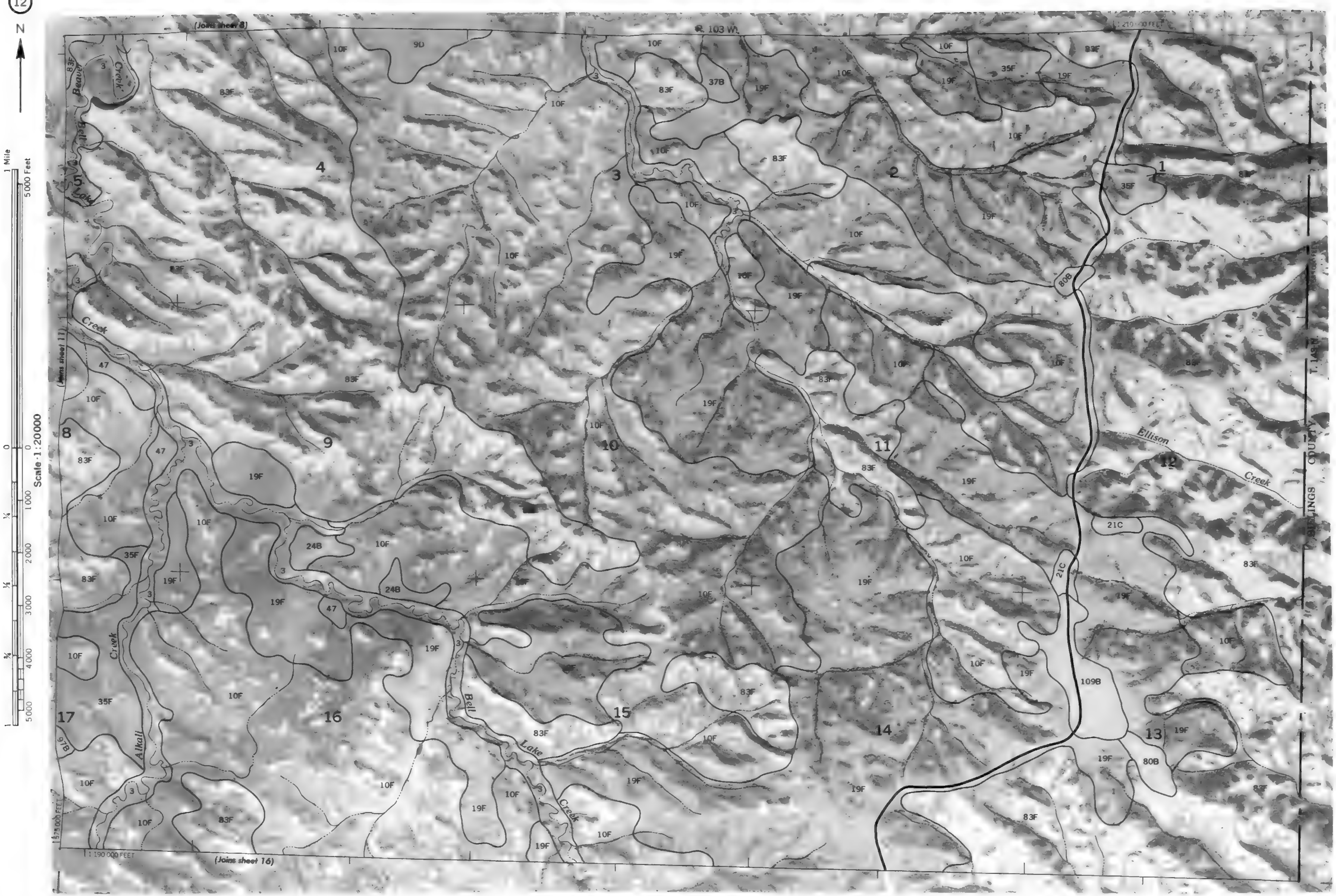


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 11

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



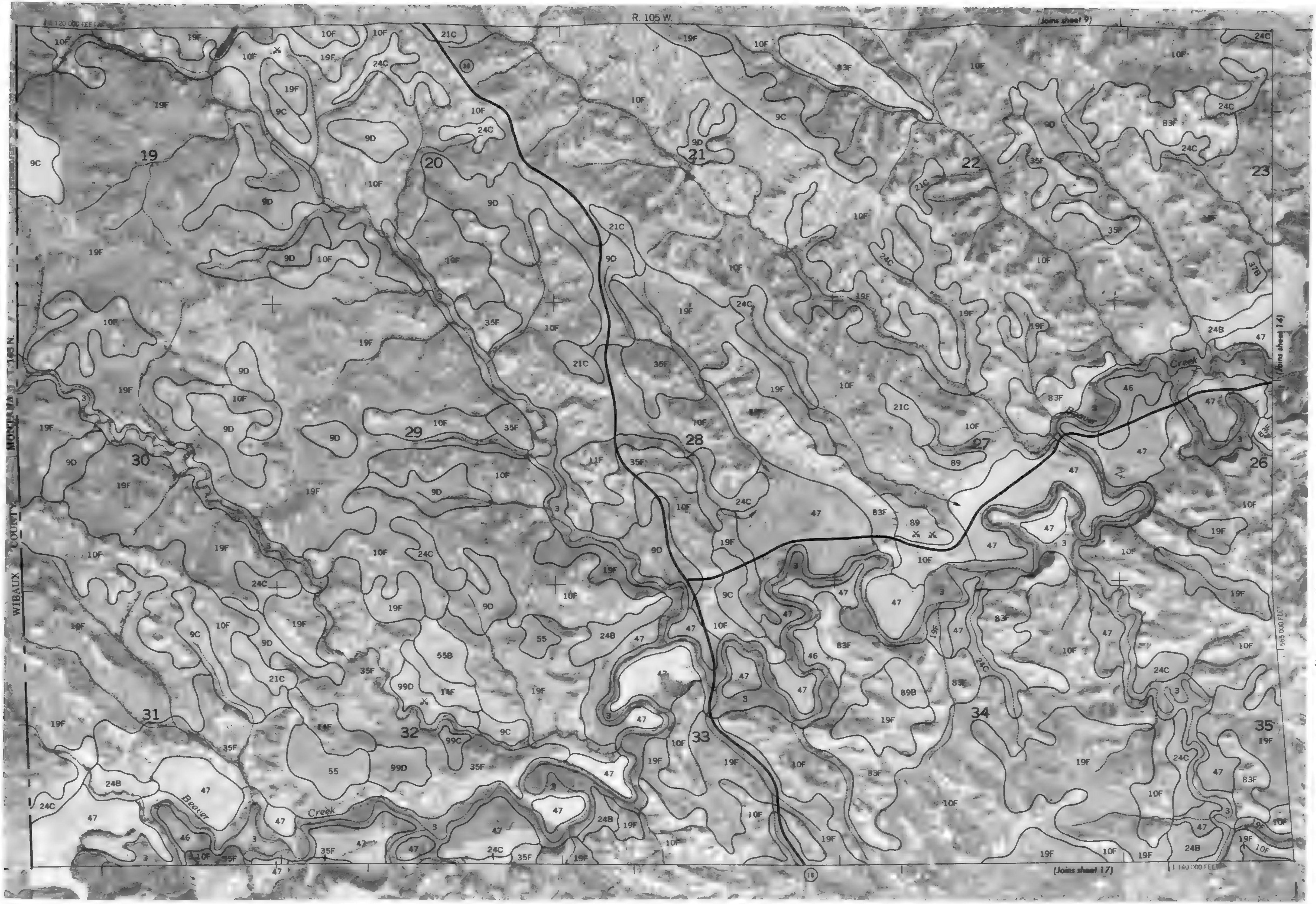
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 12

(13)

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 13

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



N

Scale 1:20000

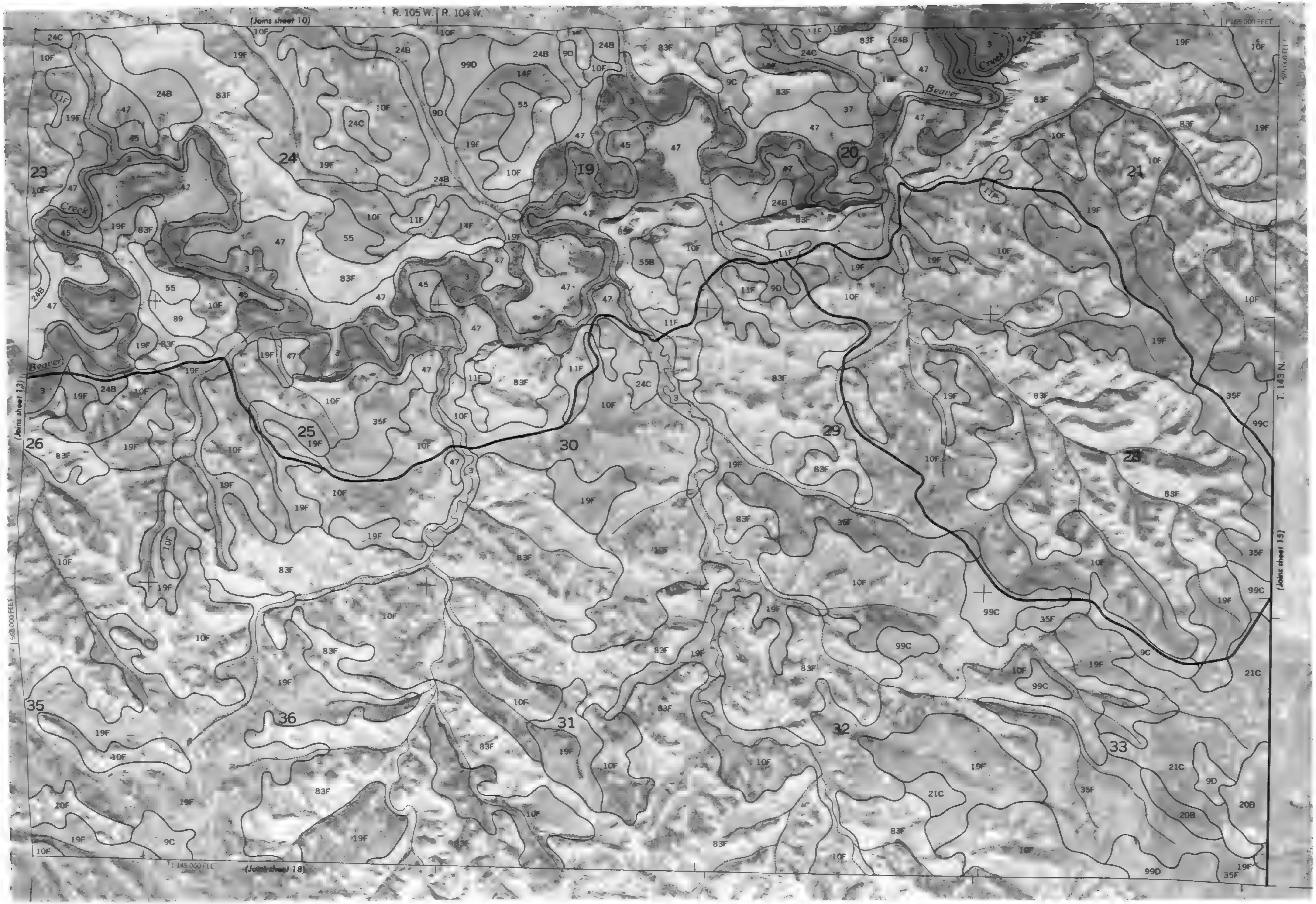
1 Mile

5000 Feet

14

N

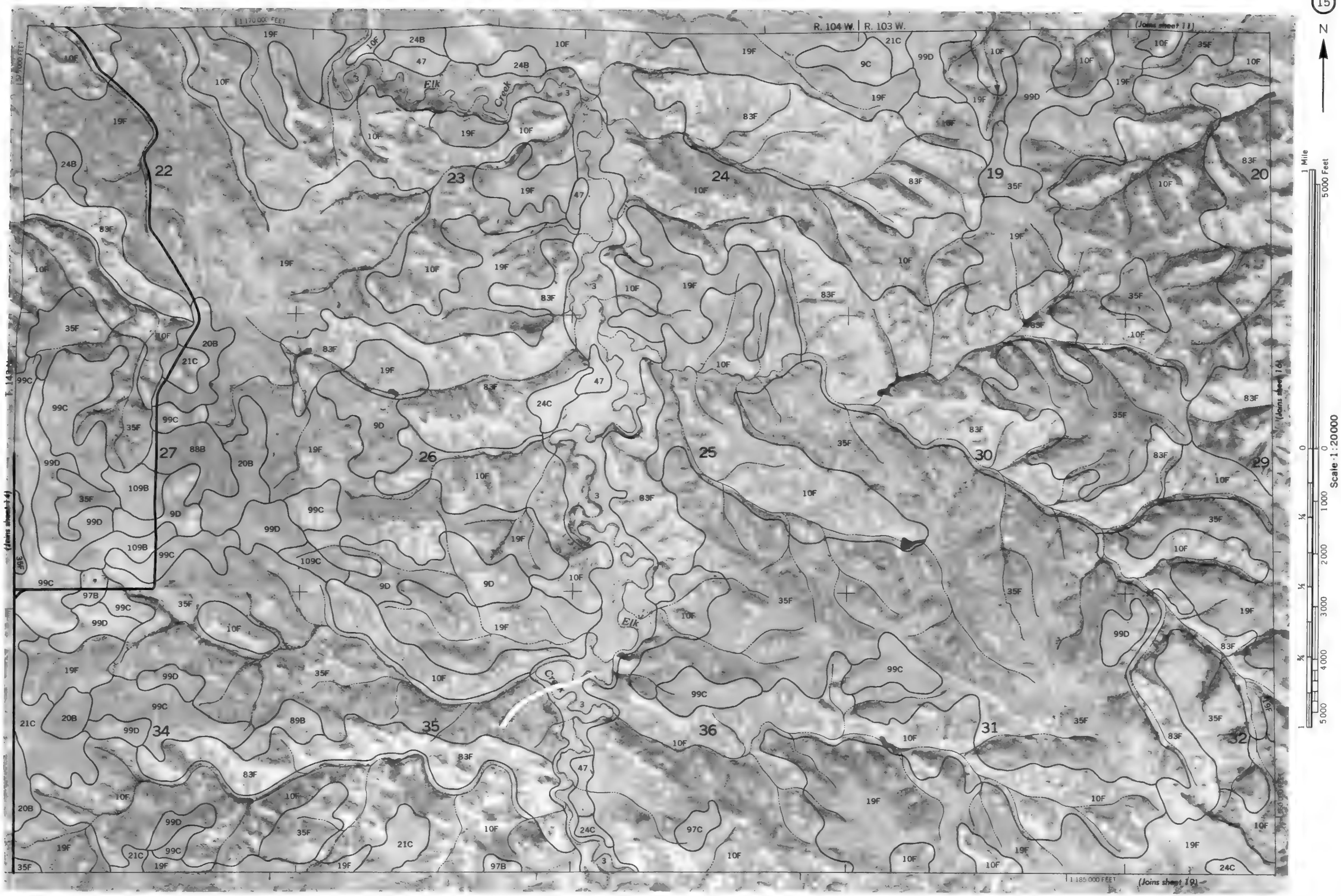
1 Mile
5000 Feet
0
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

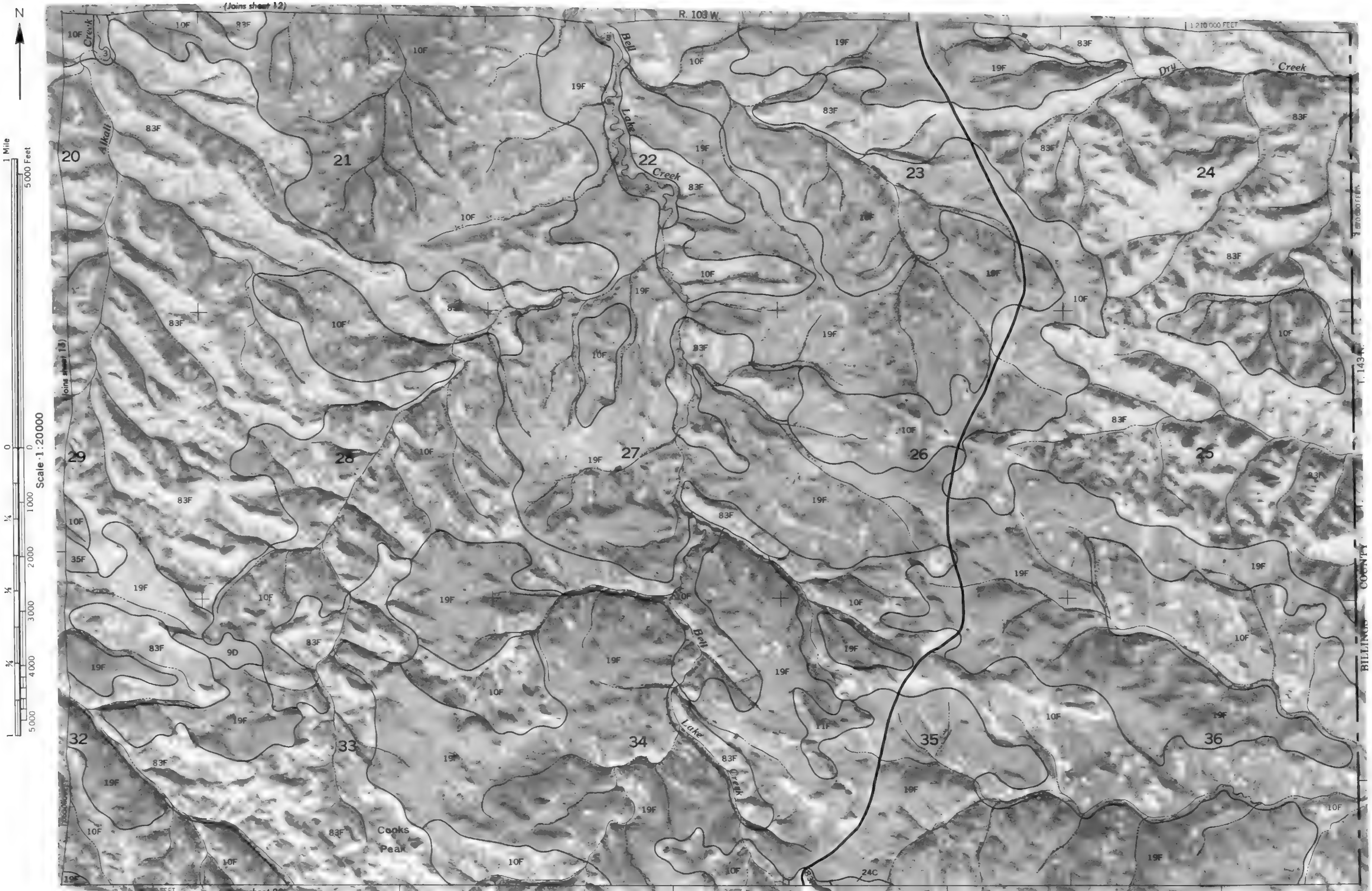
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 14

15



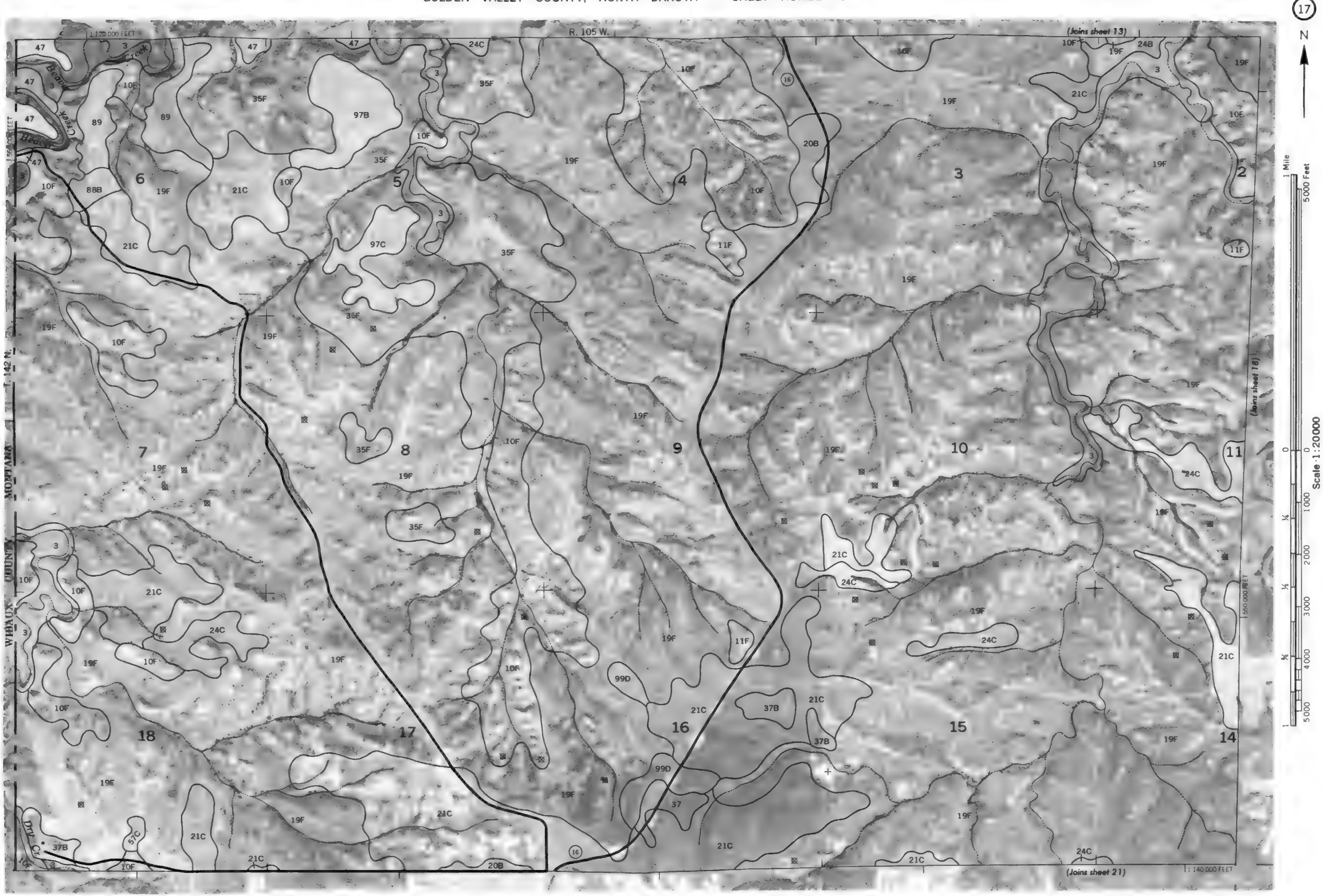
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 15

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

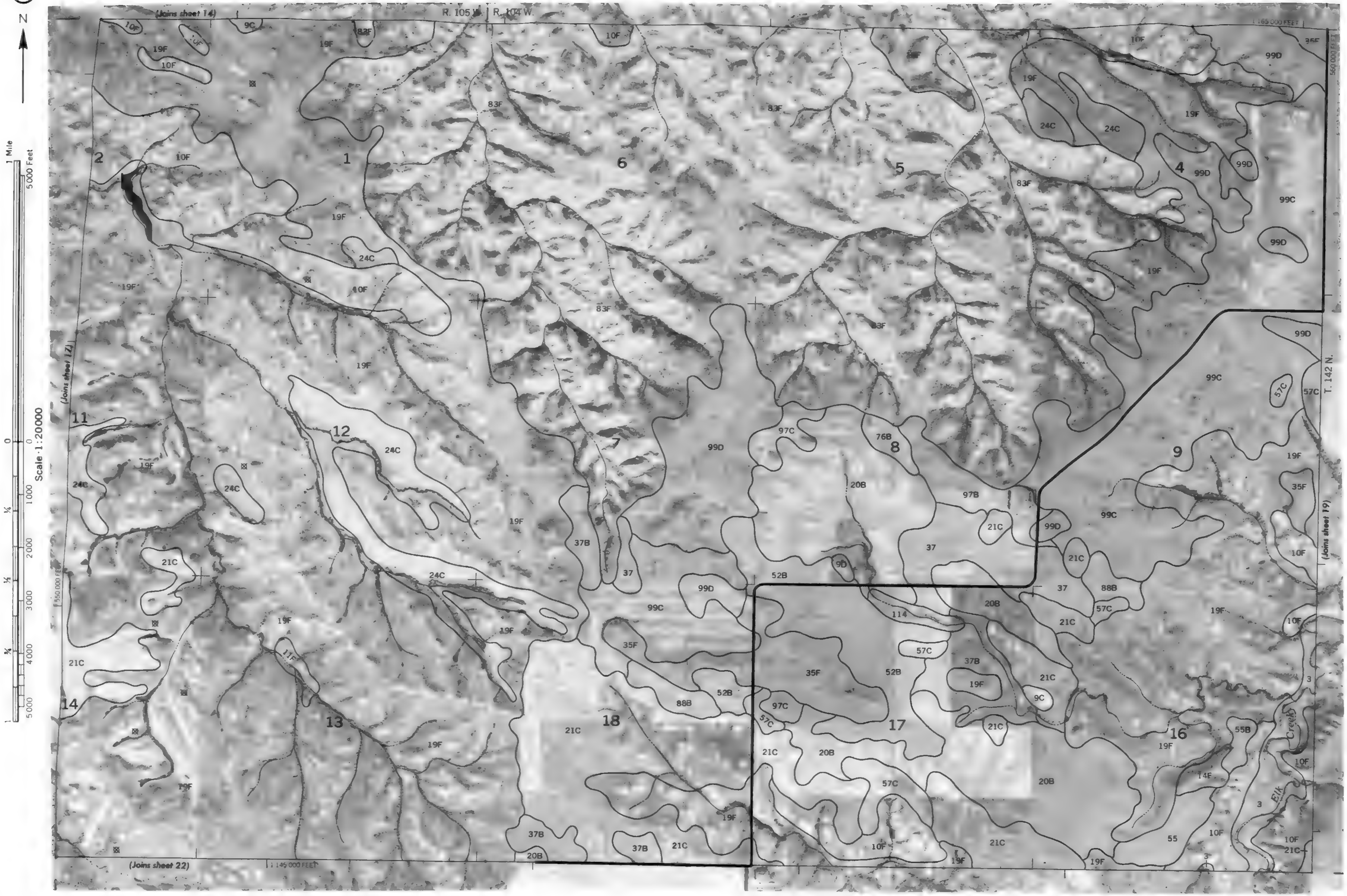


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 16

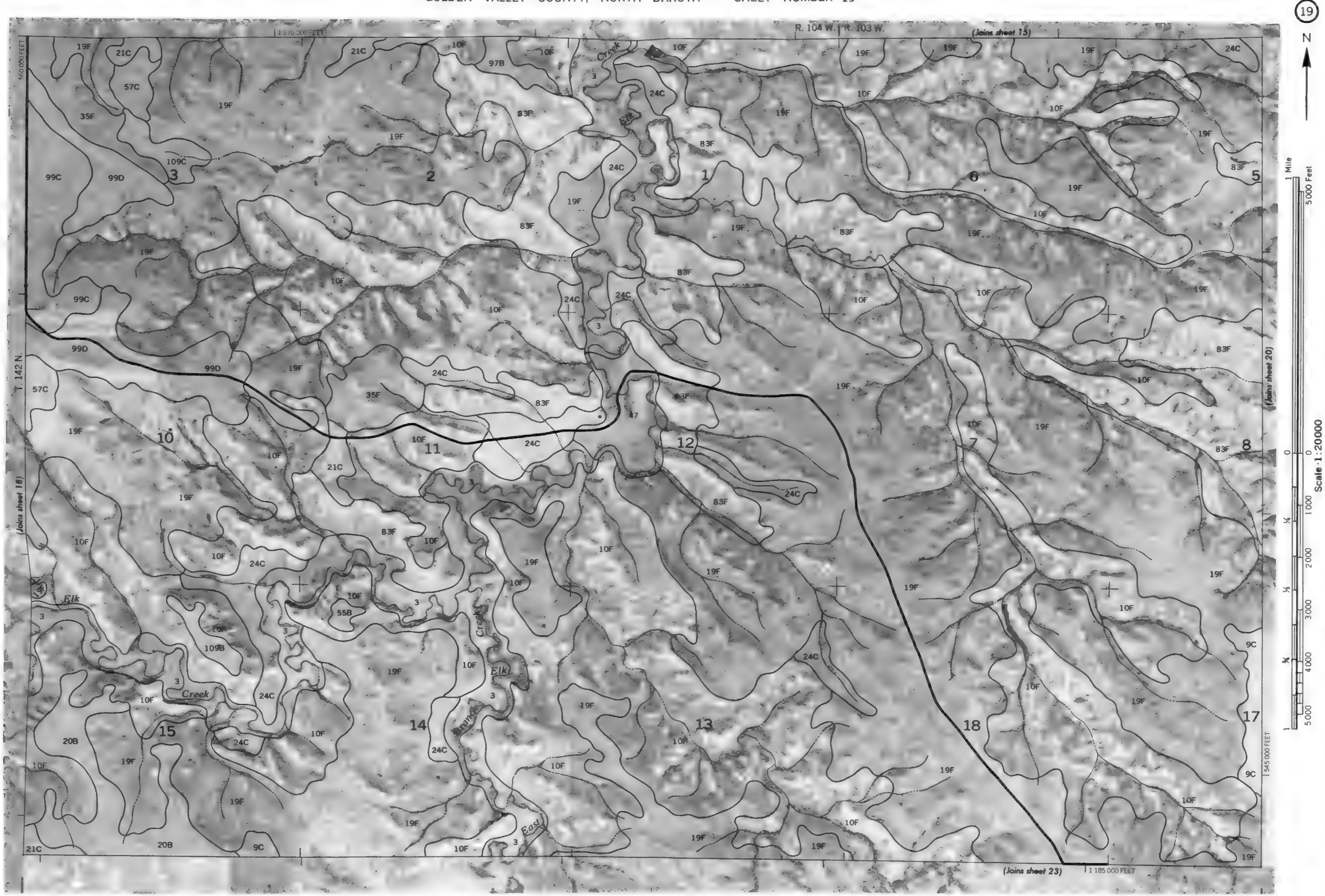


GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 17
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 18



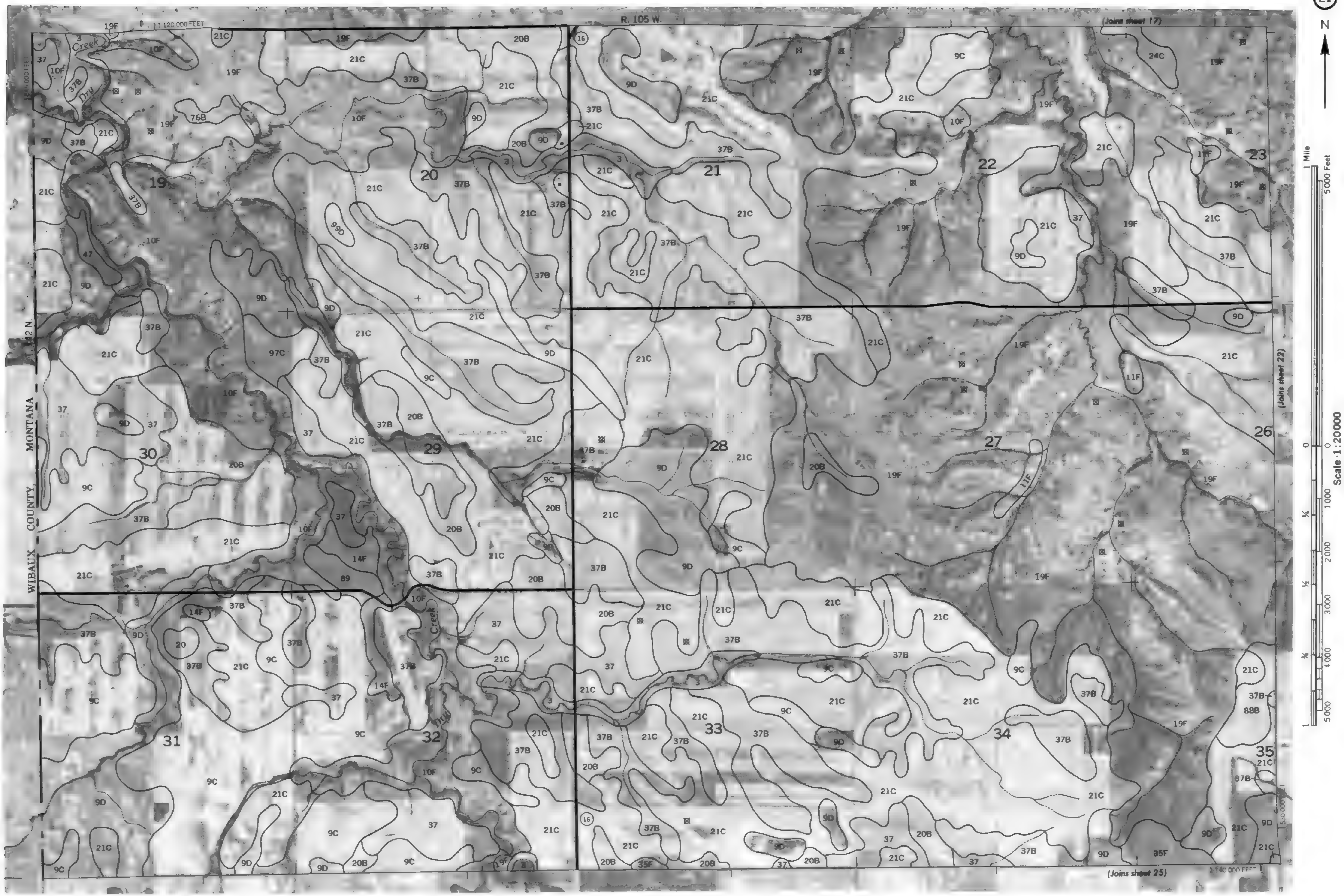
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 19

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

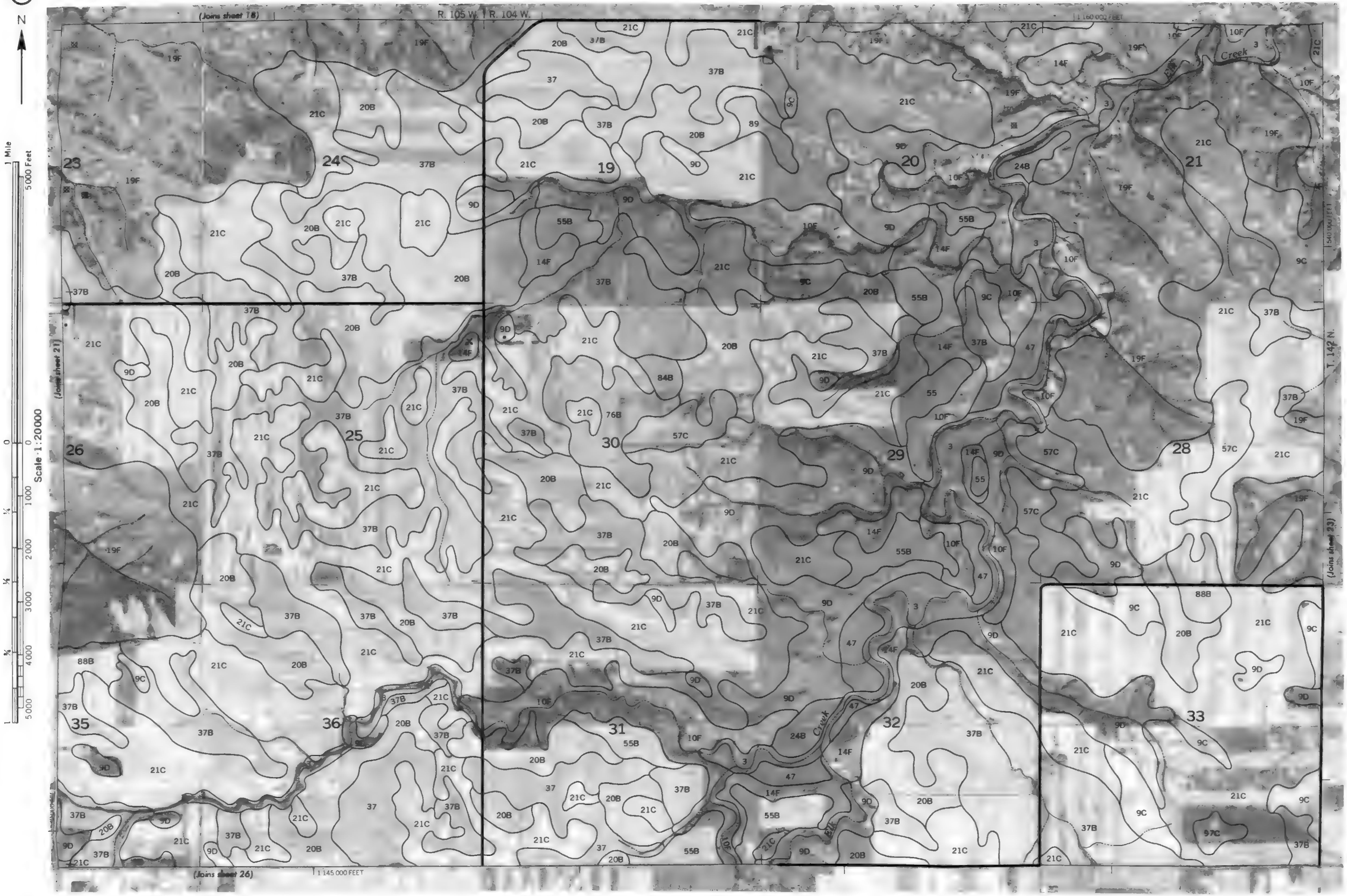
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 20

21



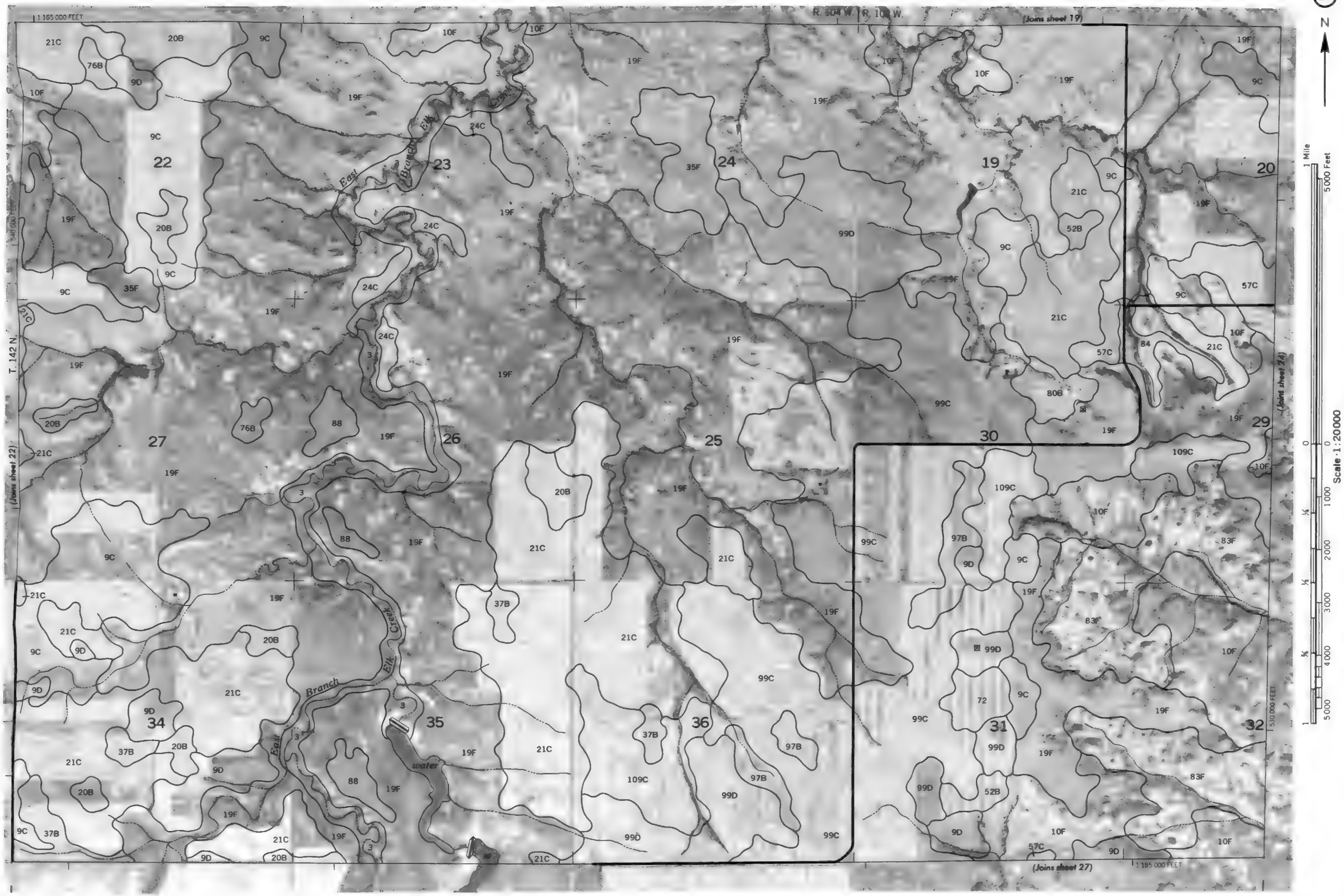
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 21

This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

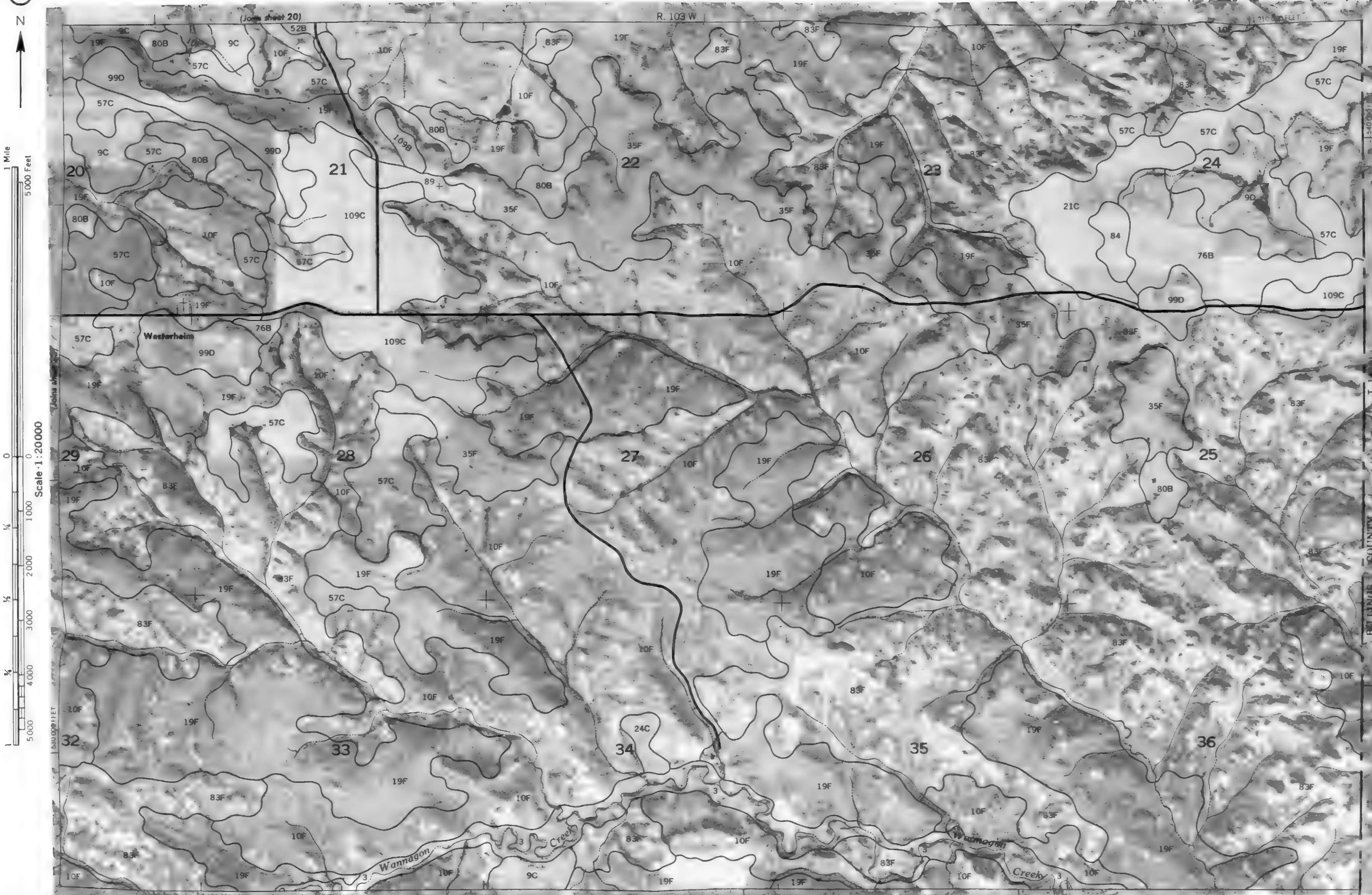
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 22



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 23

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

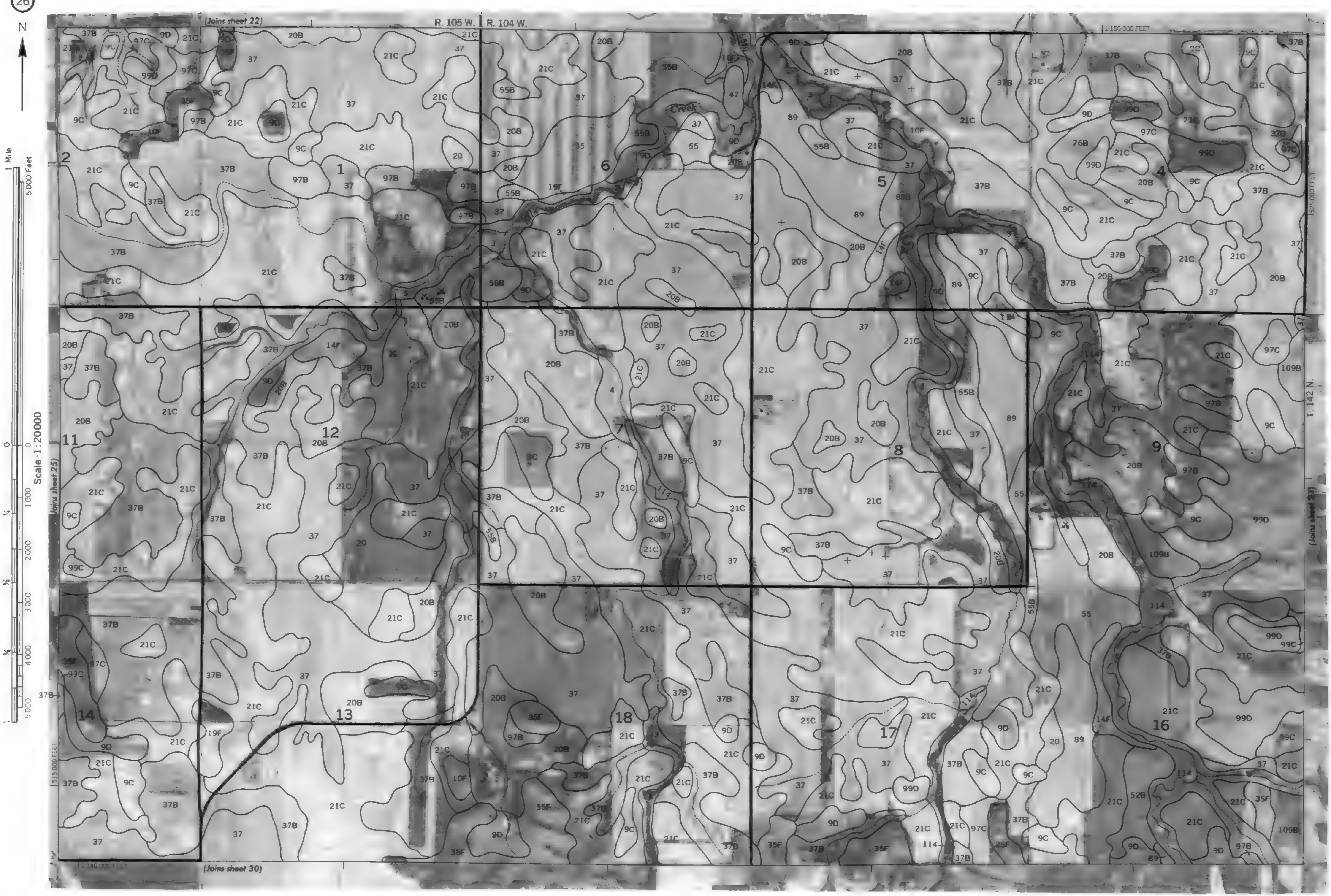
24



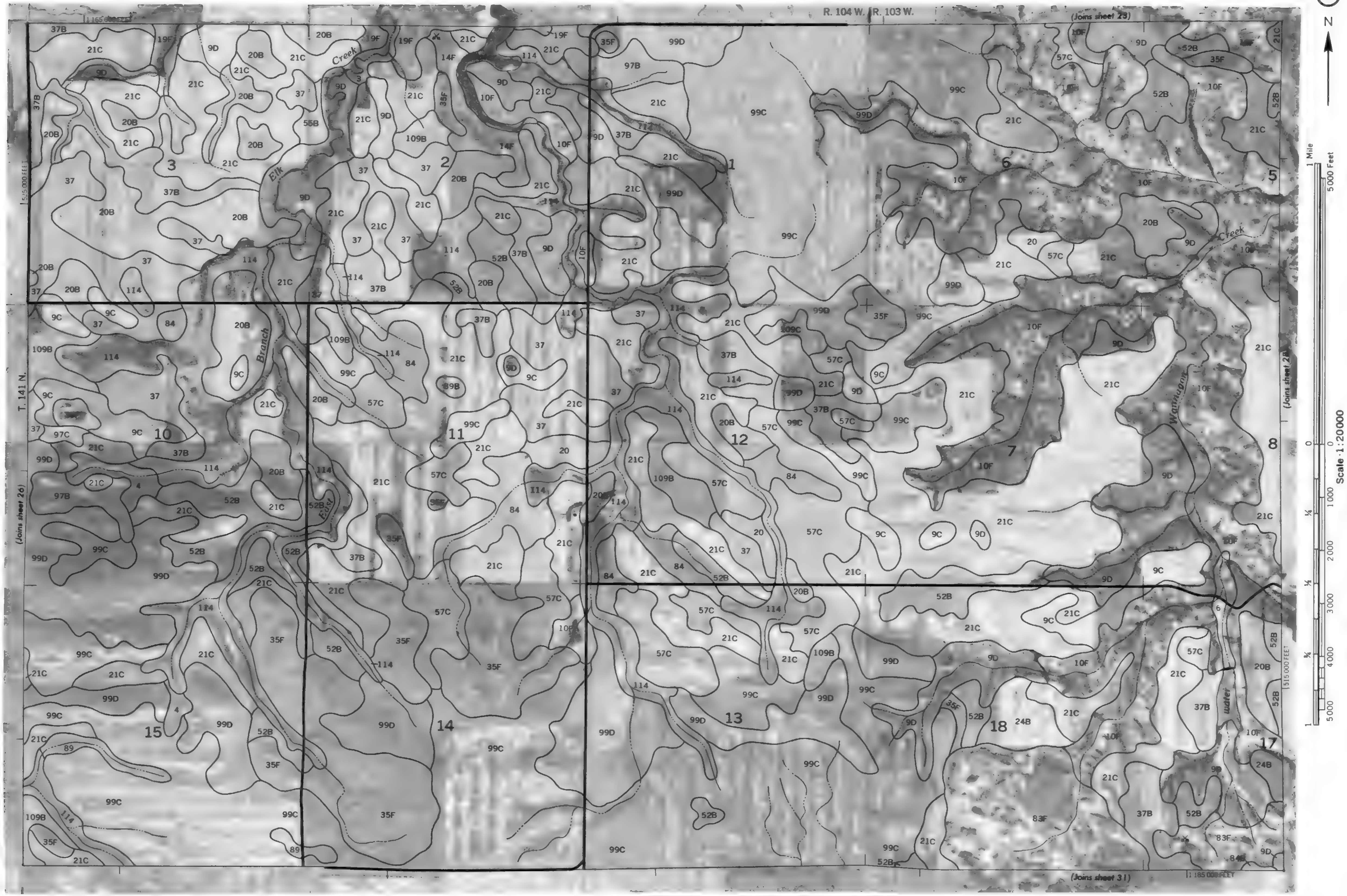
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 25

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

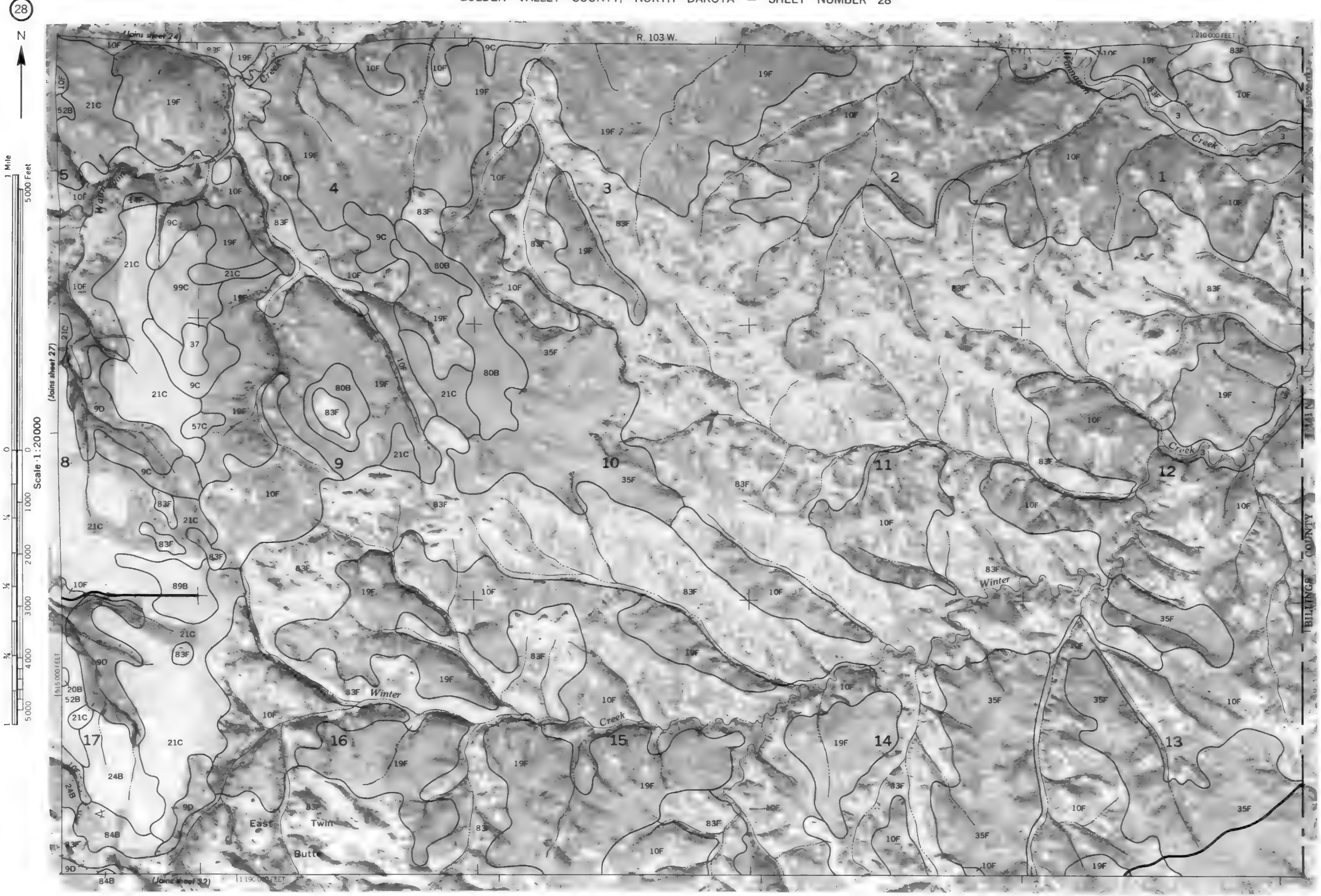


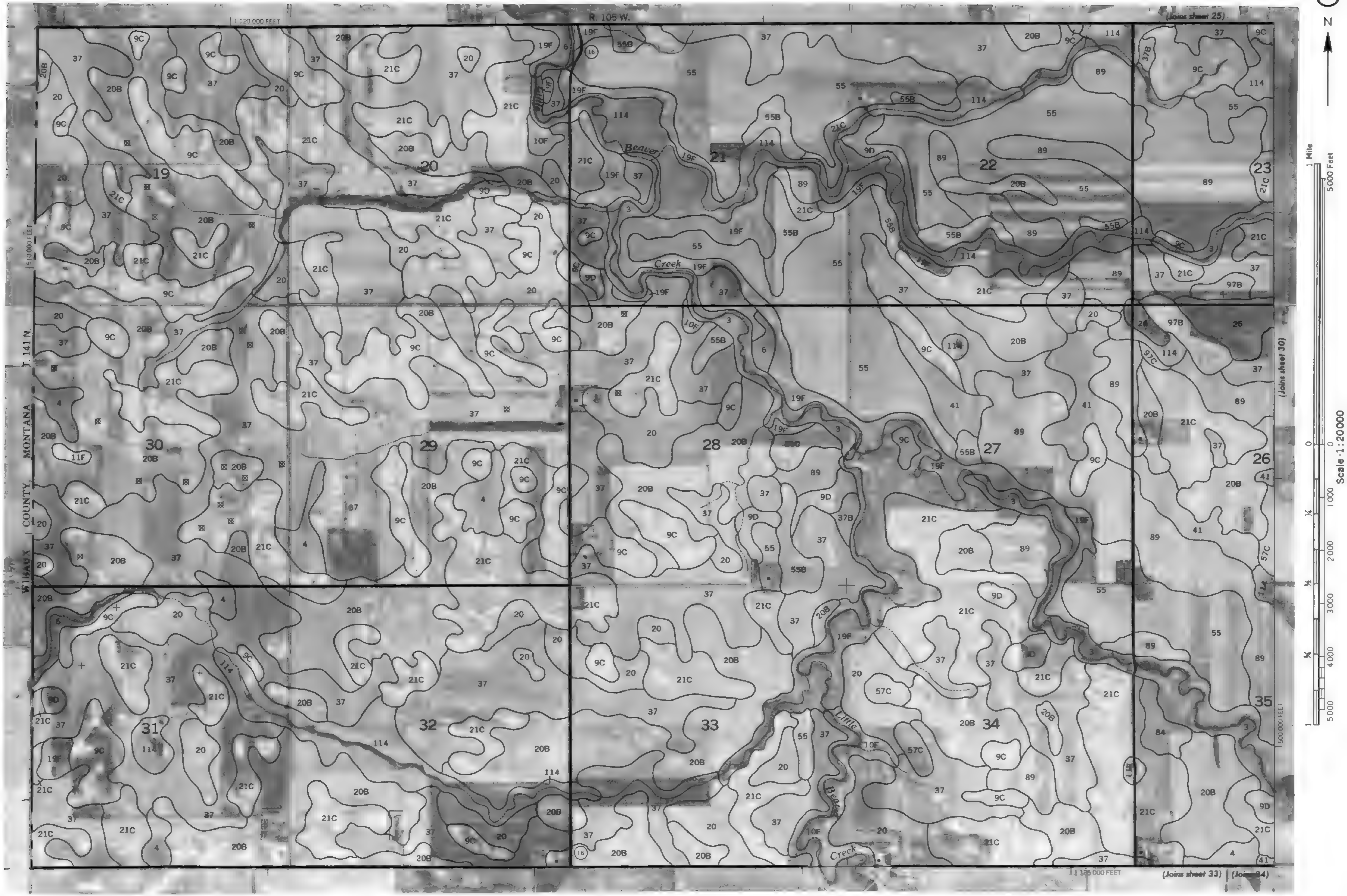
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 26



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 27

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

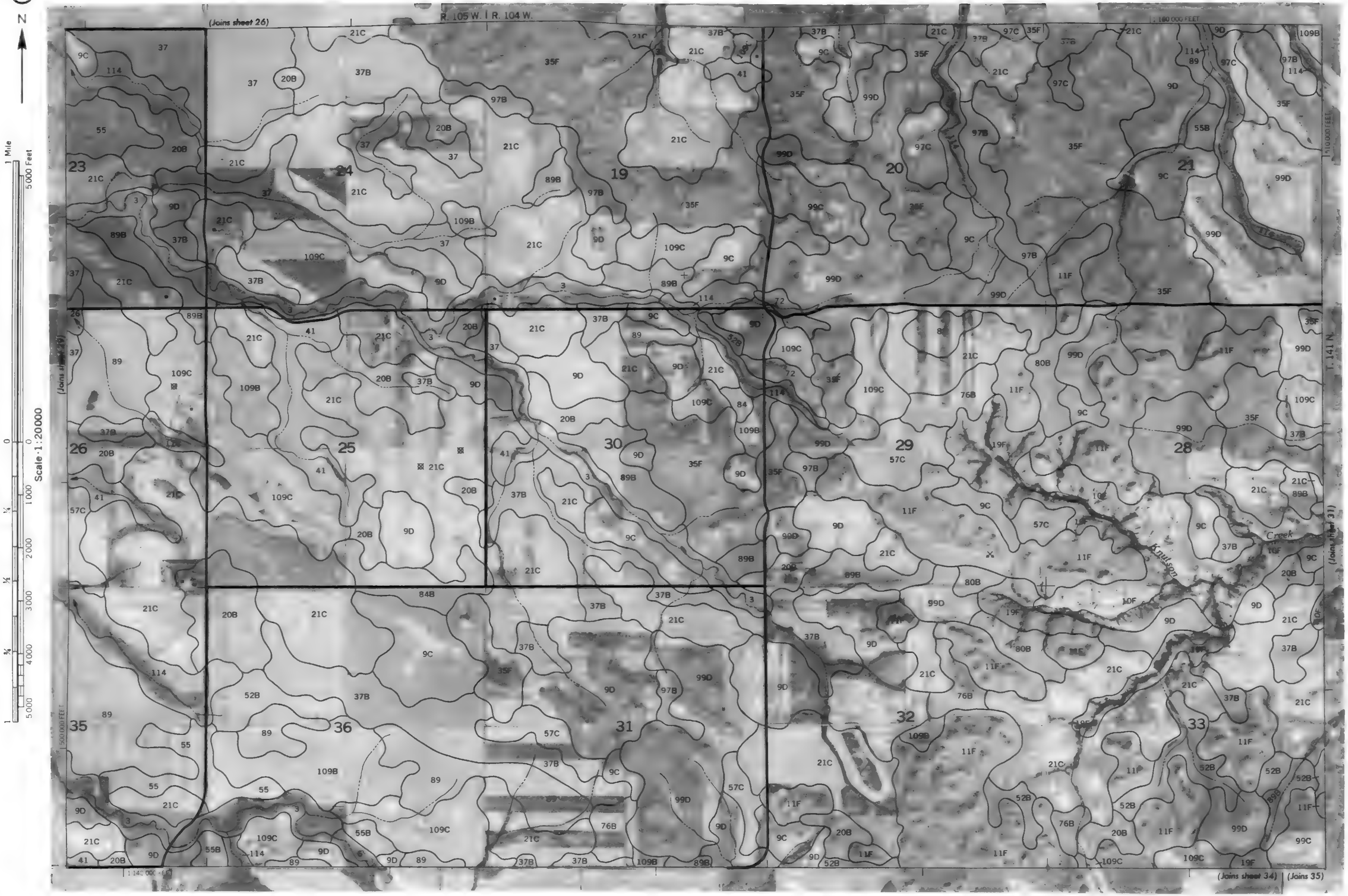

28
N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 24)
(Joins sheet 27)
(Joins sheet 32)
R. 103 W.
BILLINGS COUNTY
Winter Creek
Creek
East Twin Butte
1 2 3 4 5 8 9 10 11 12 13 14 15 16 17
10F 19F 21C 9C 83F 80B 35F 37 57C 89B 24B 84B 9D 20B 52B 99C 3



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 29

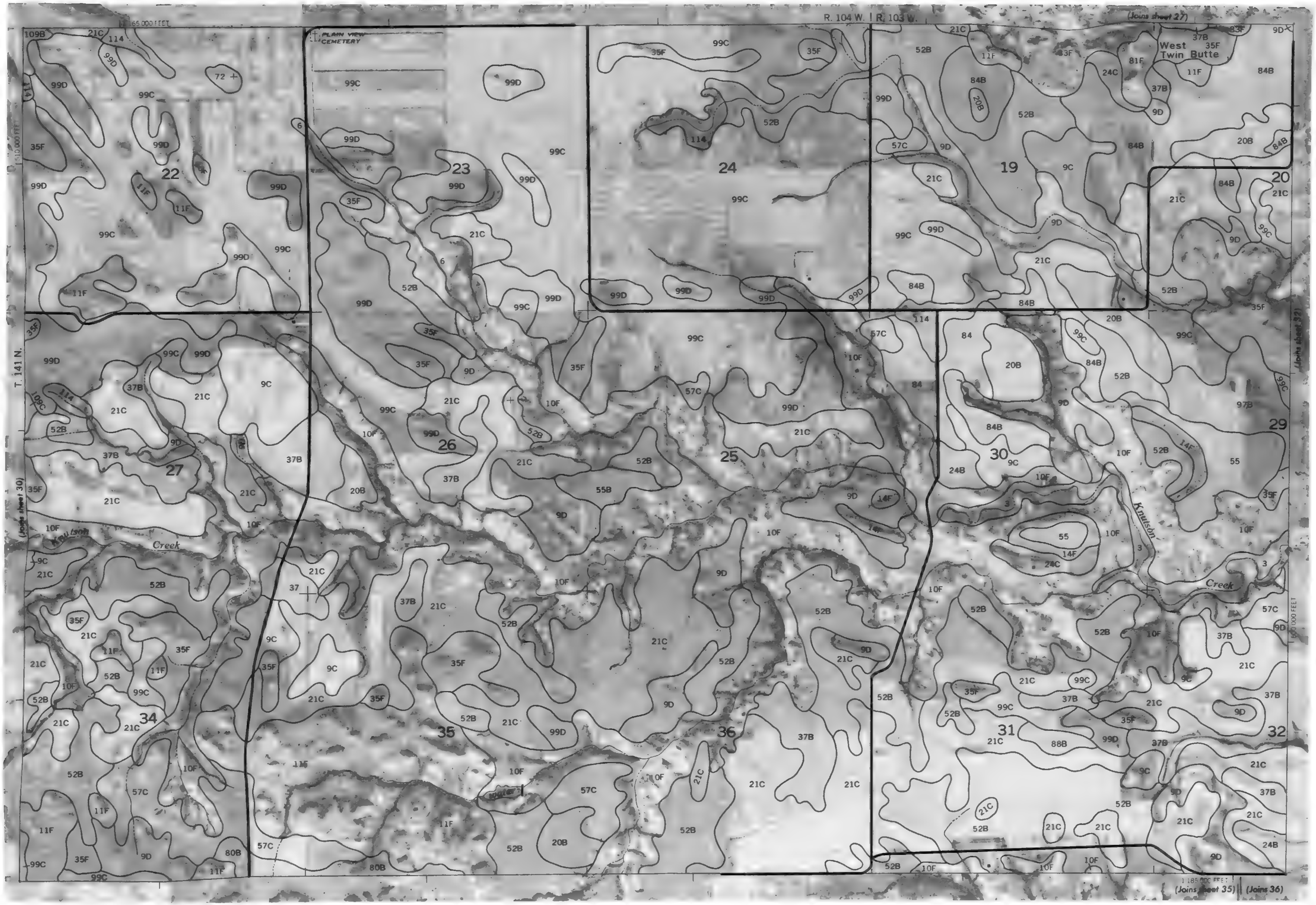
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 30



This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

31

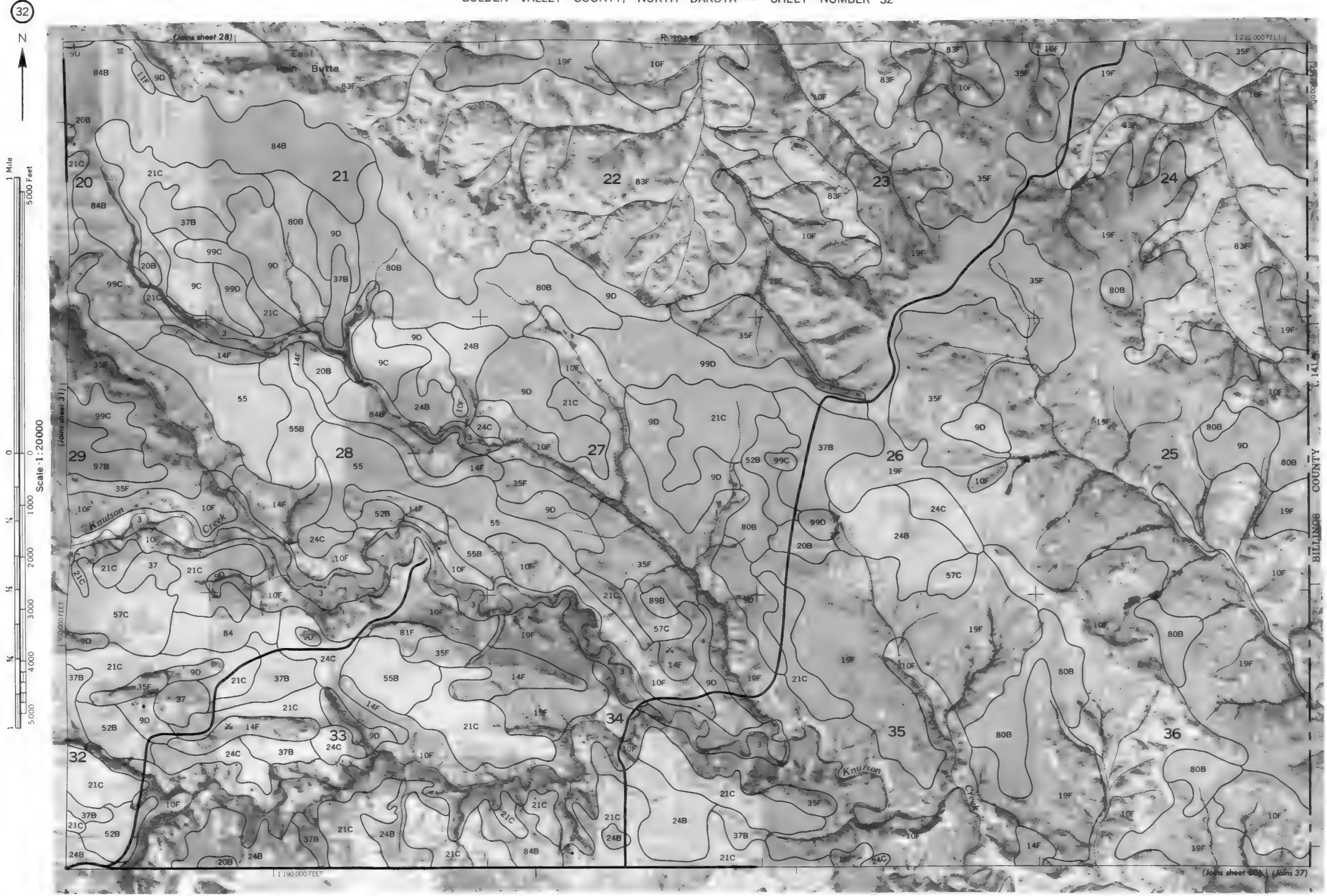


N

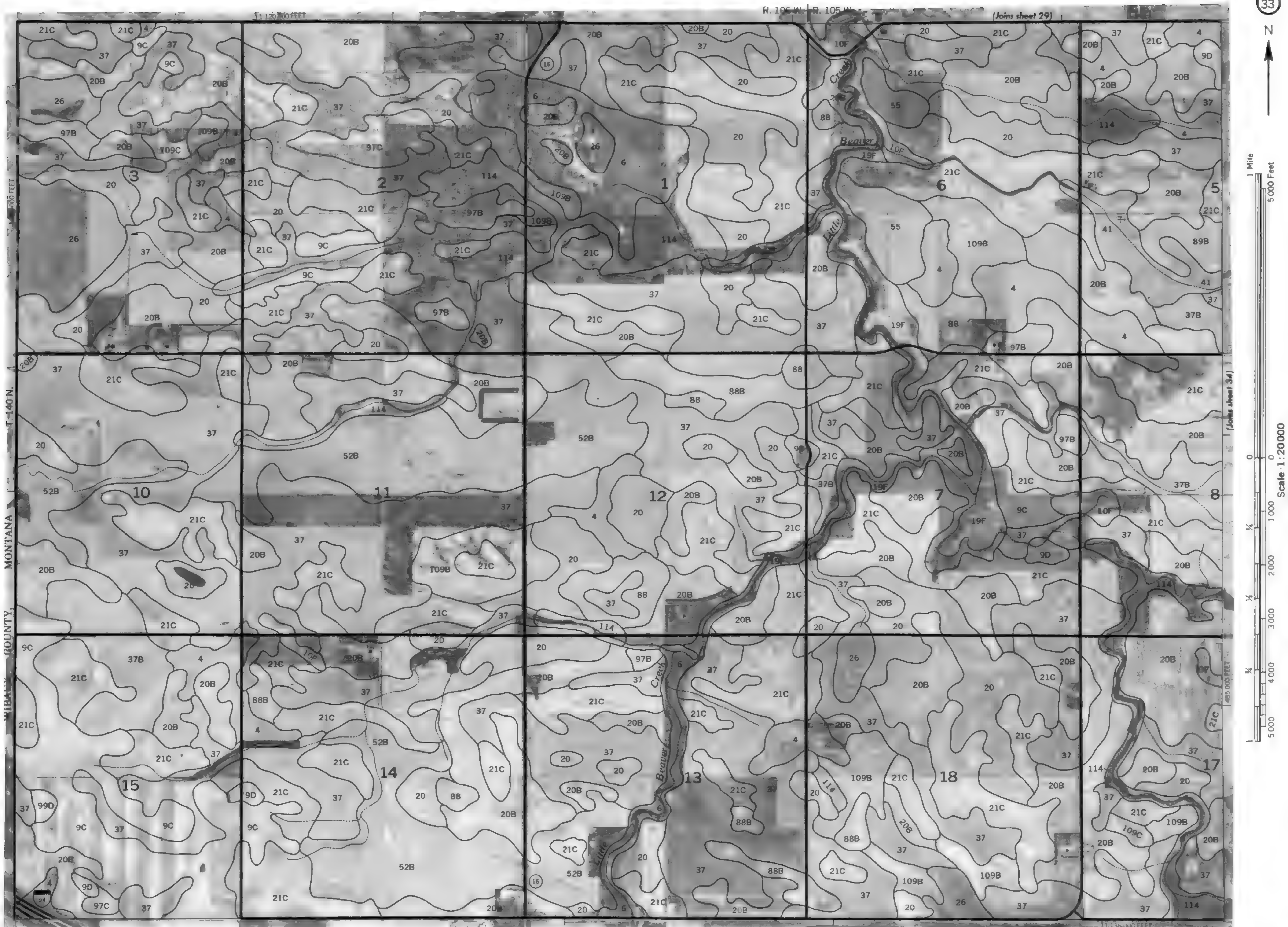
1 Mile
5000 Feet
Scale 1:20000

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 31

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

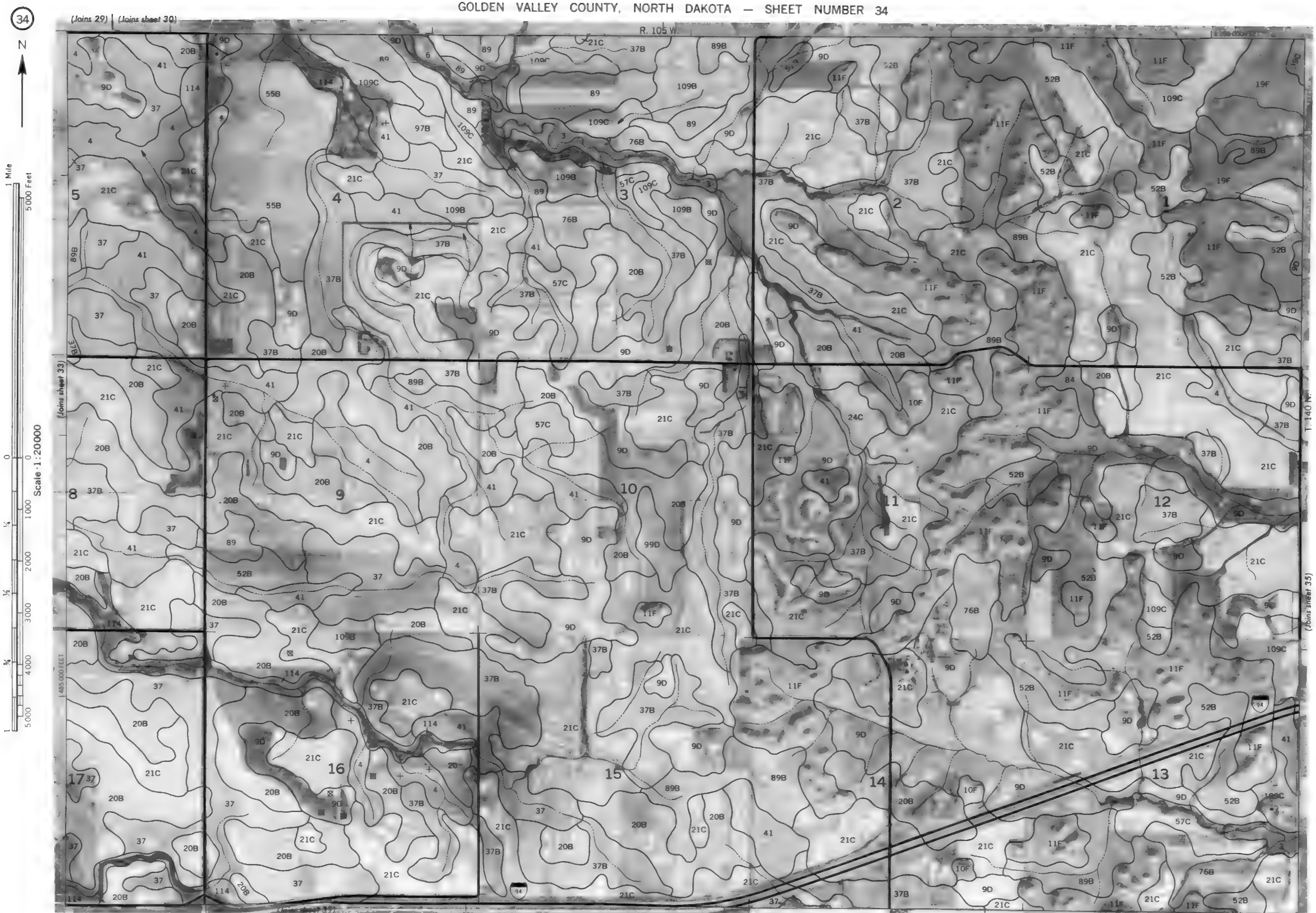


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 33

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

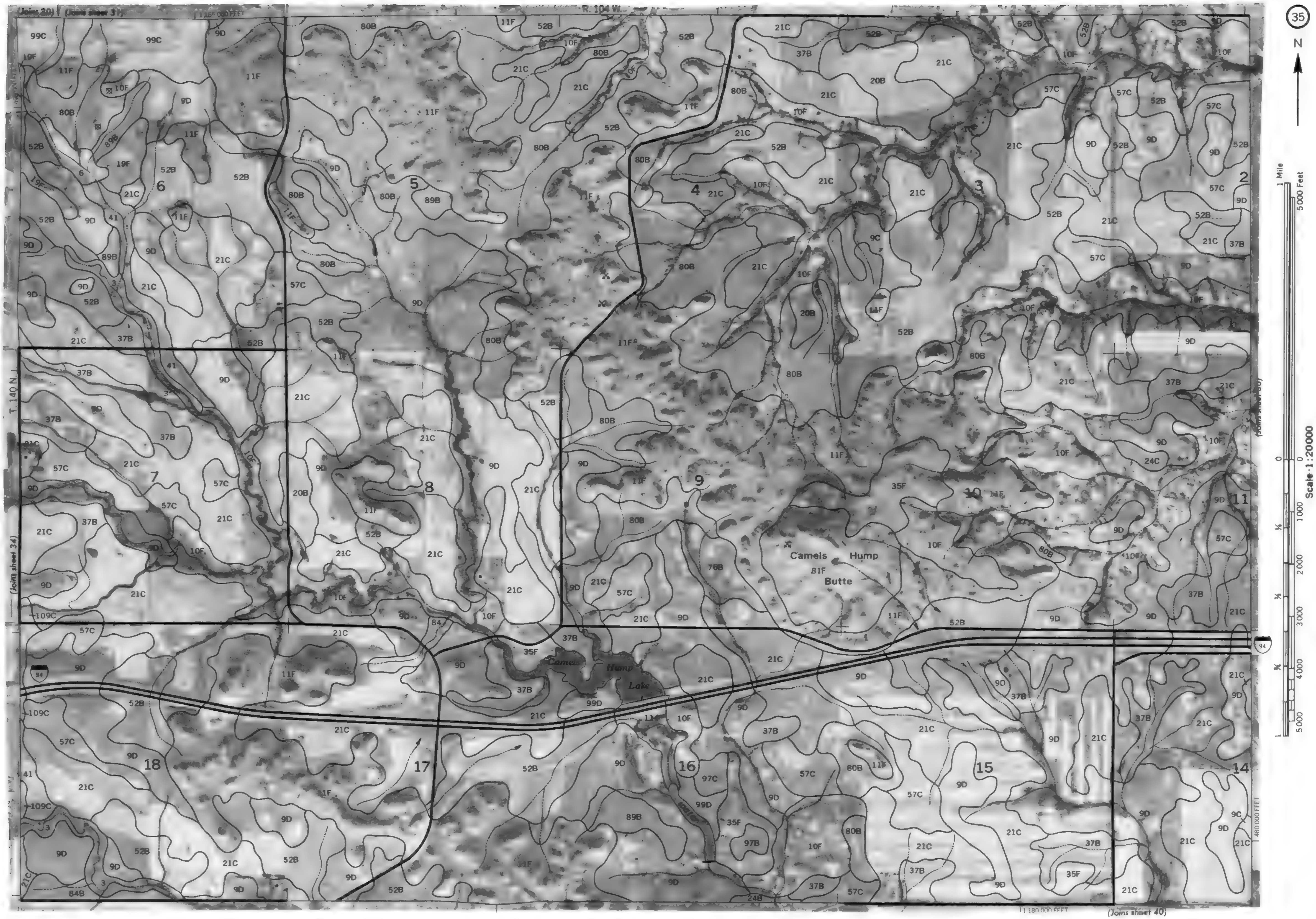


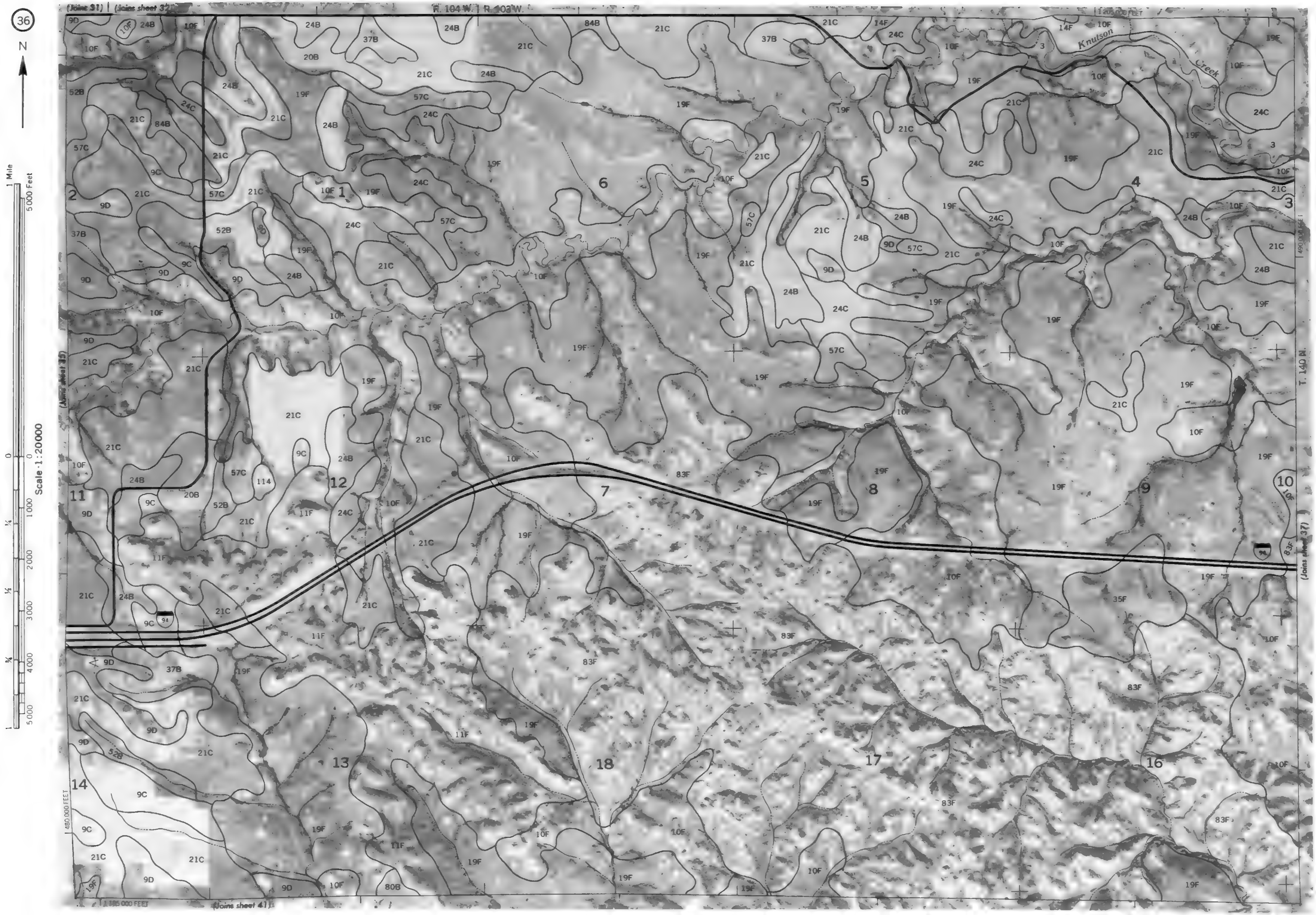
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 35

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 35





GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 36

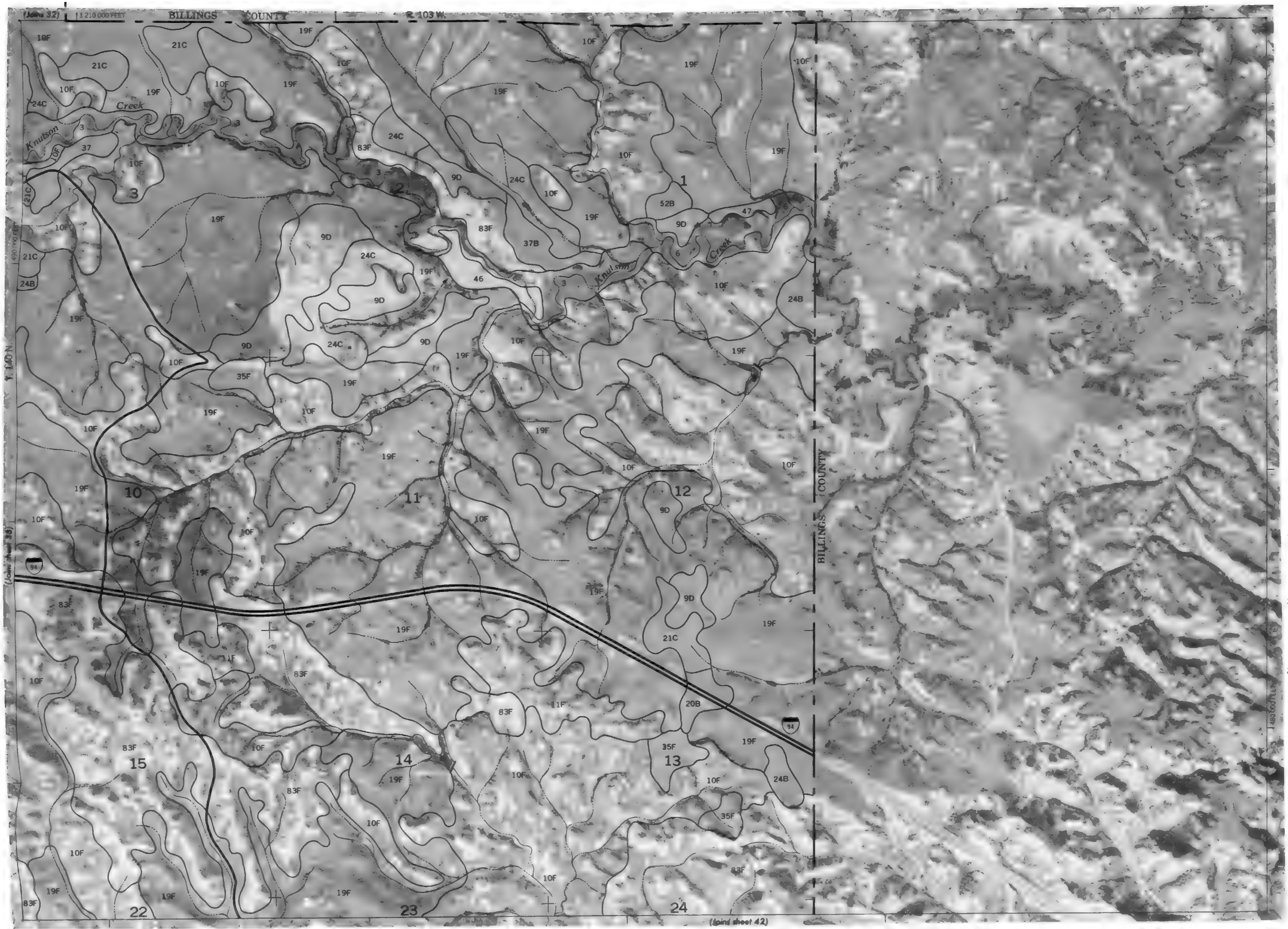
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 36

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 37

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

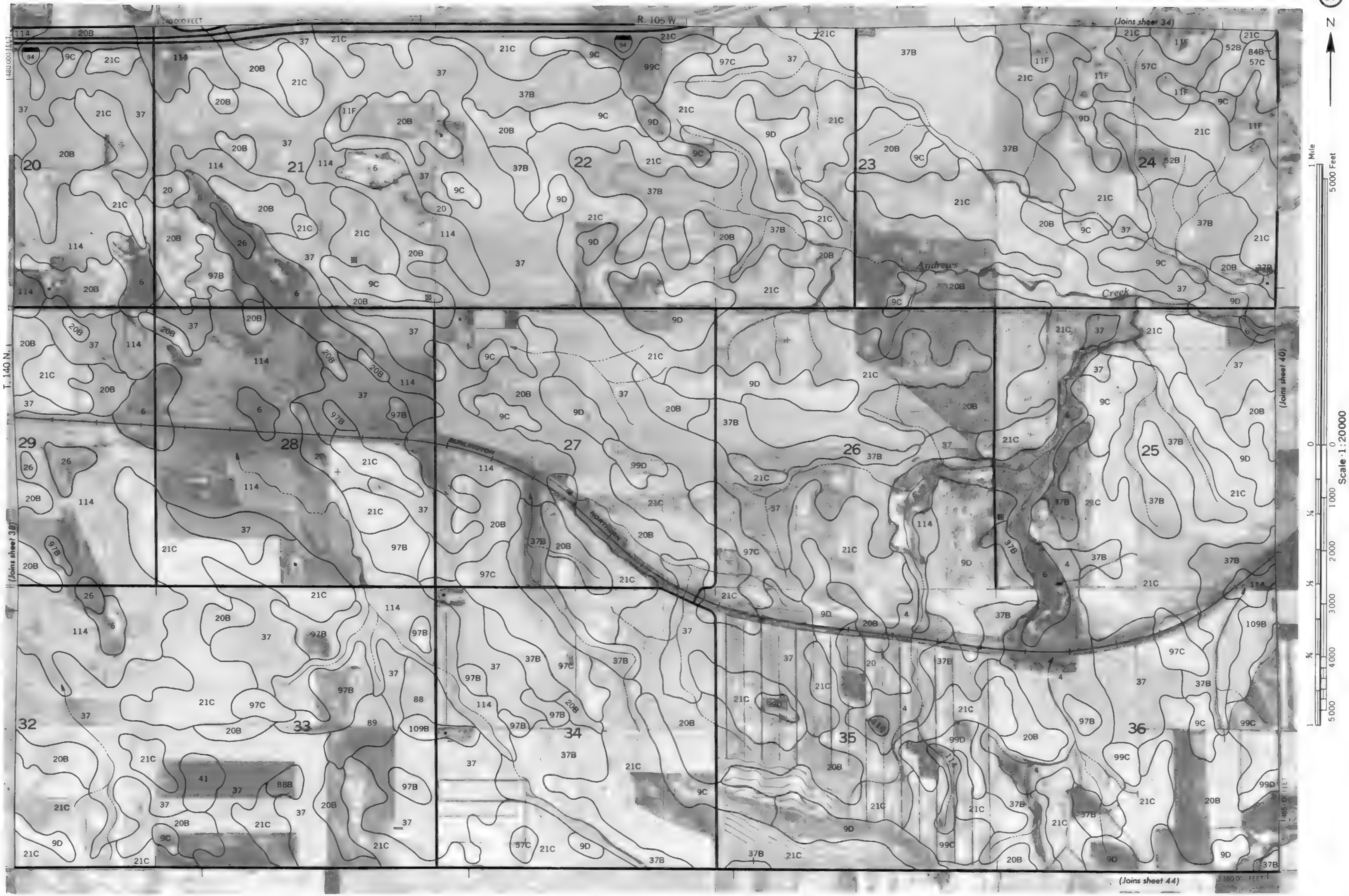
GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 37



N

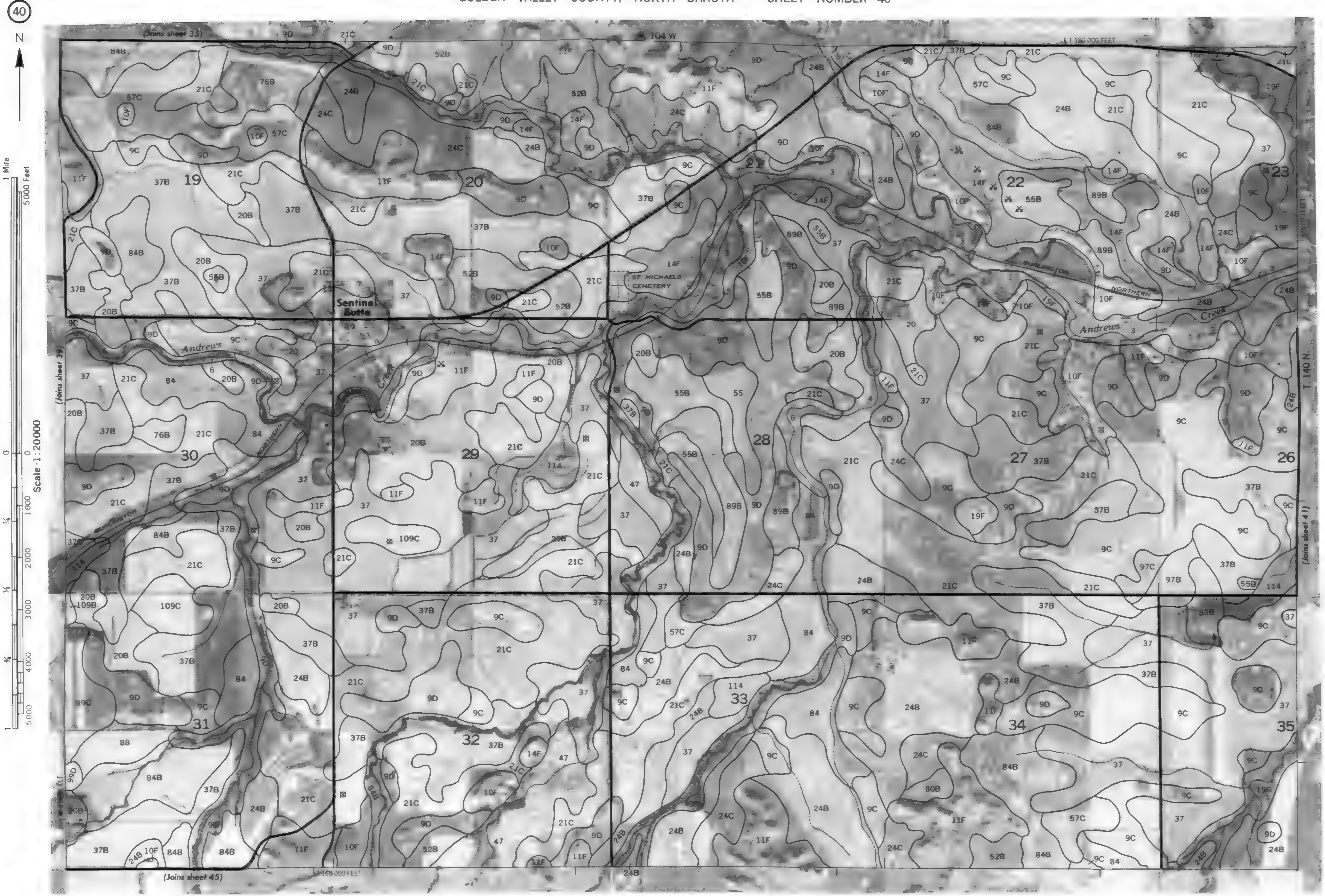
1 Mile
5000 Feet
Scale 1:20000

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 39

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

Scale 1:20000

1 Mile

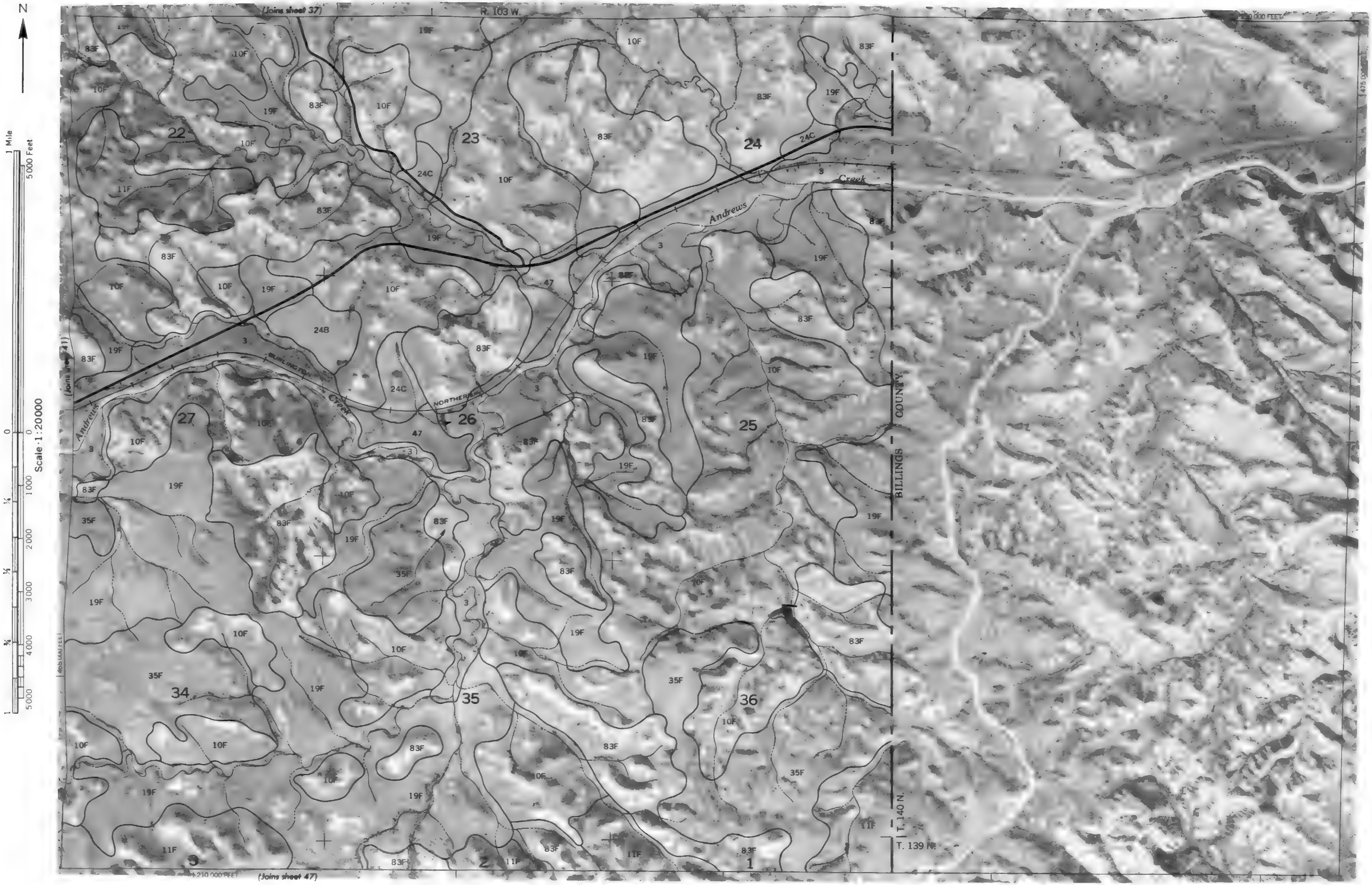
5000 Feet

0 ¼ ½ ¾

0 1000 2000 3000 4000 5000

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 41

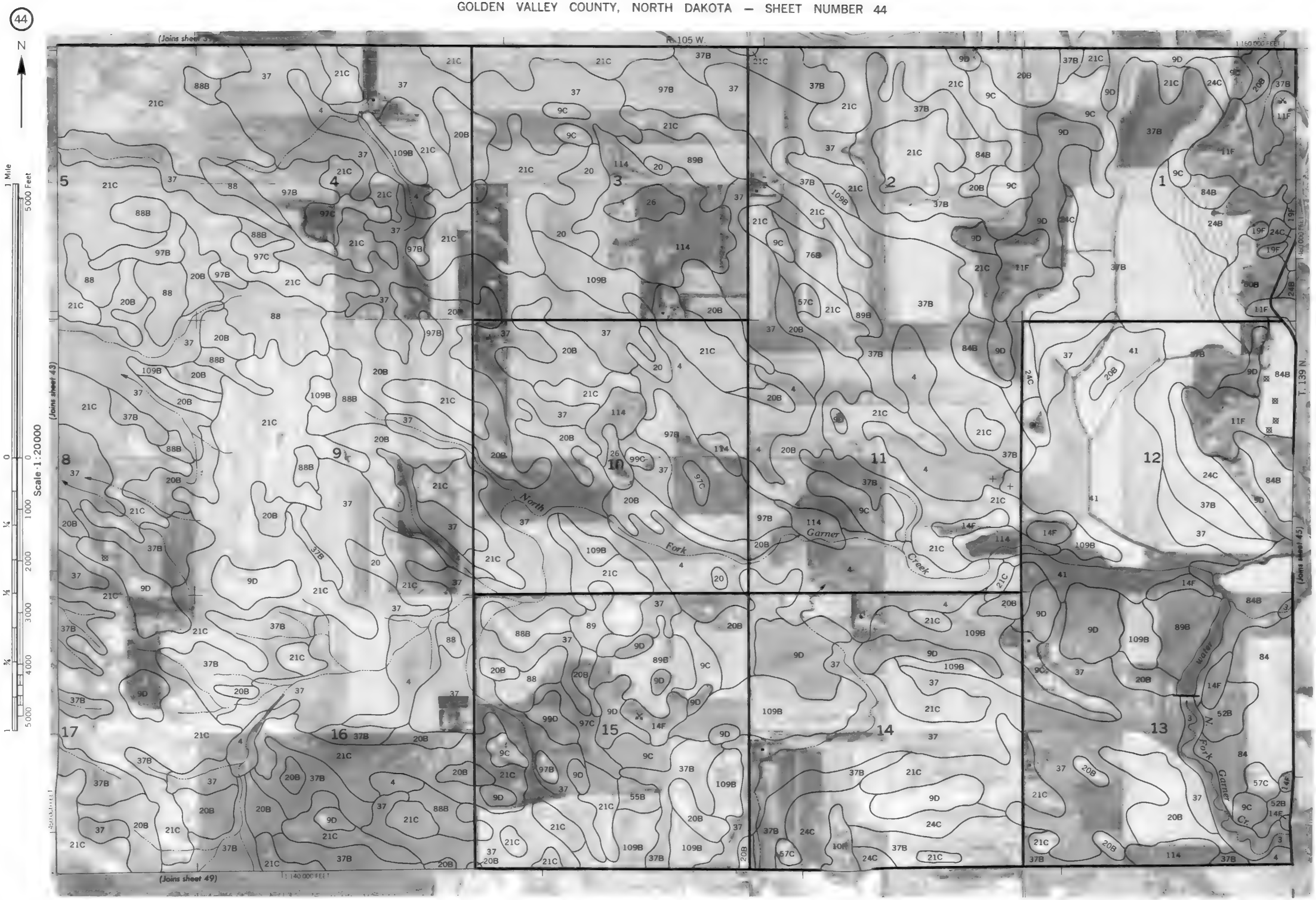
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

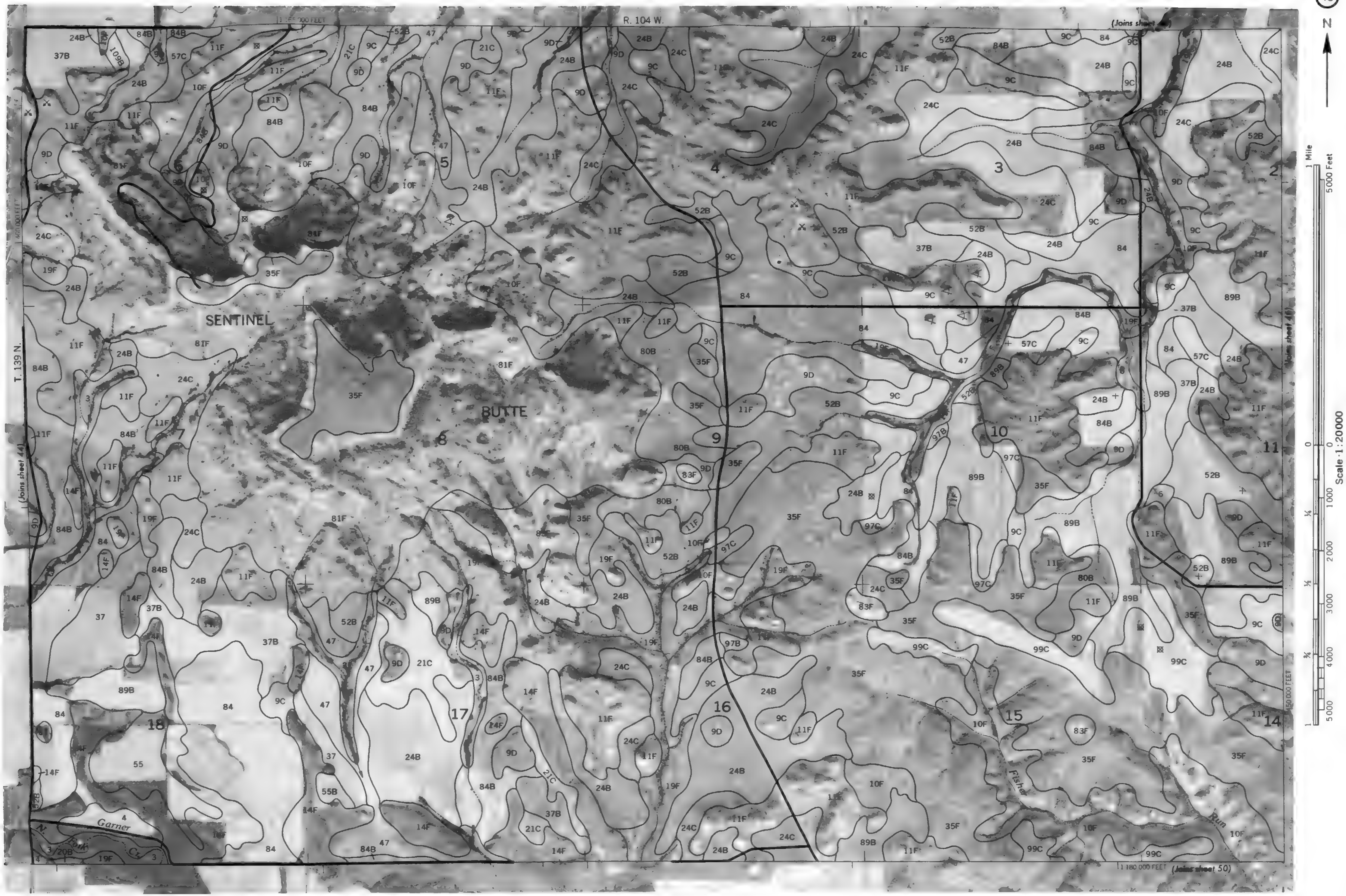
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 43

This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



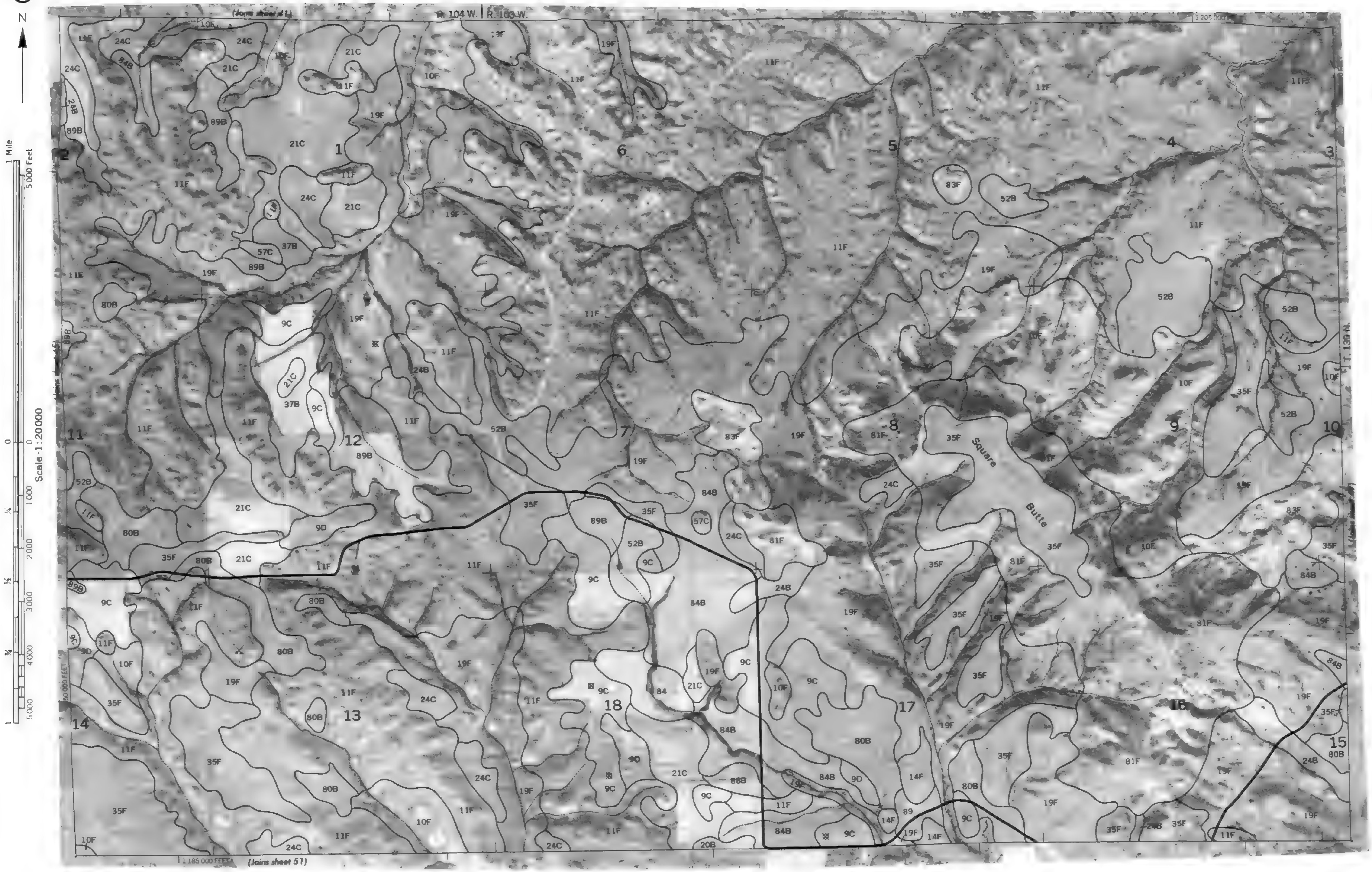
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 44



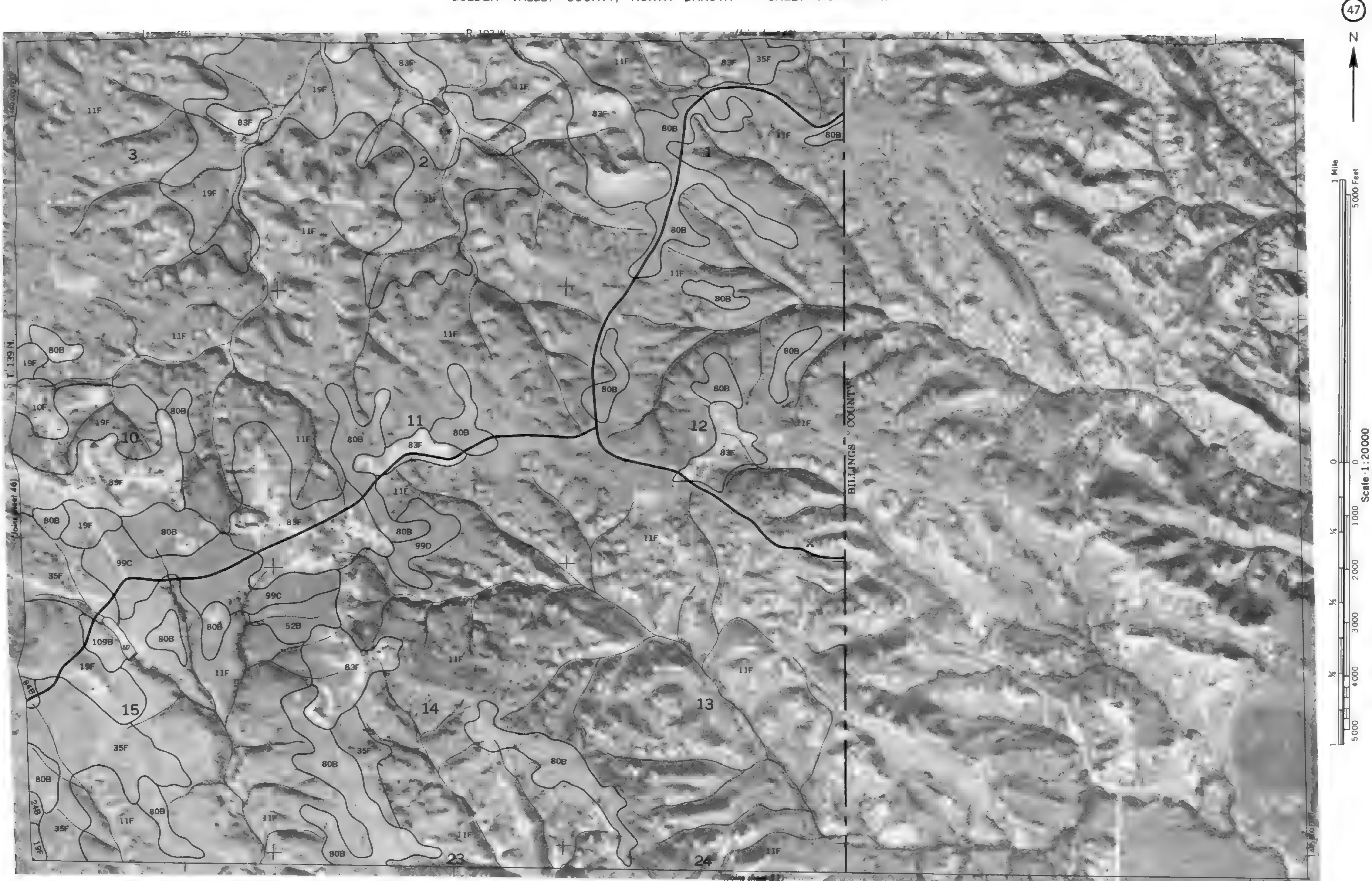
GOLDEN VALLEY COUNTY NORTH DAKOTA NO. 45

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



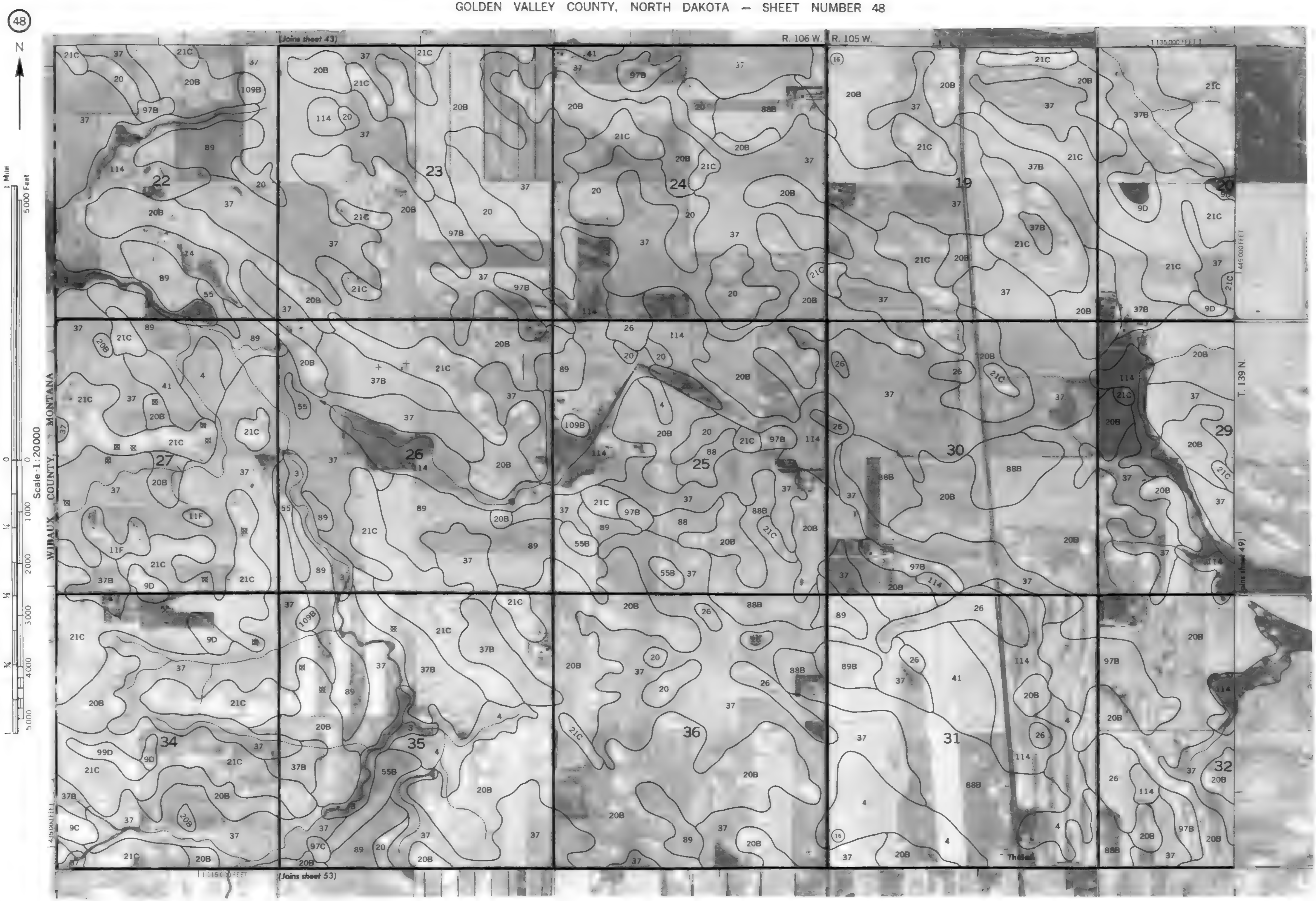
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 46

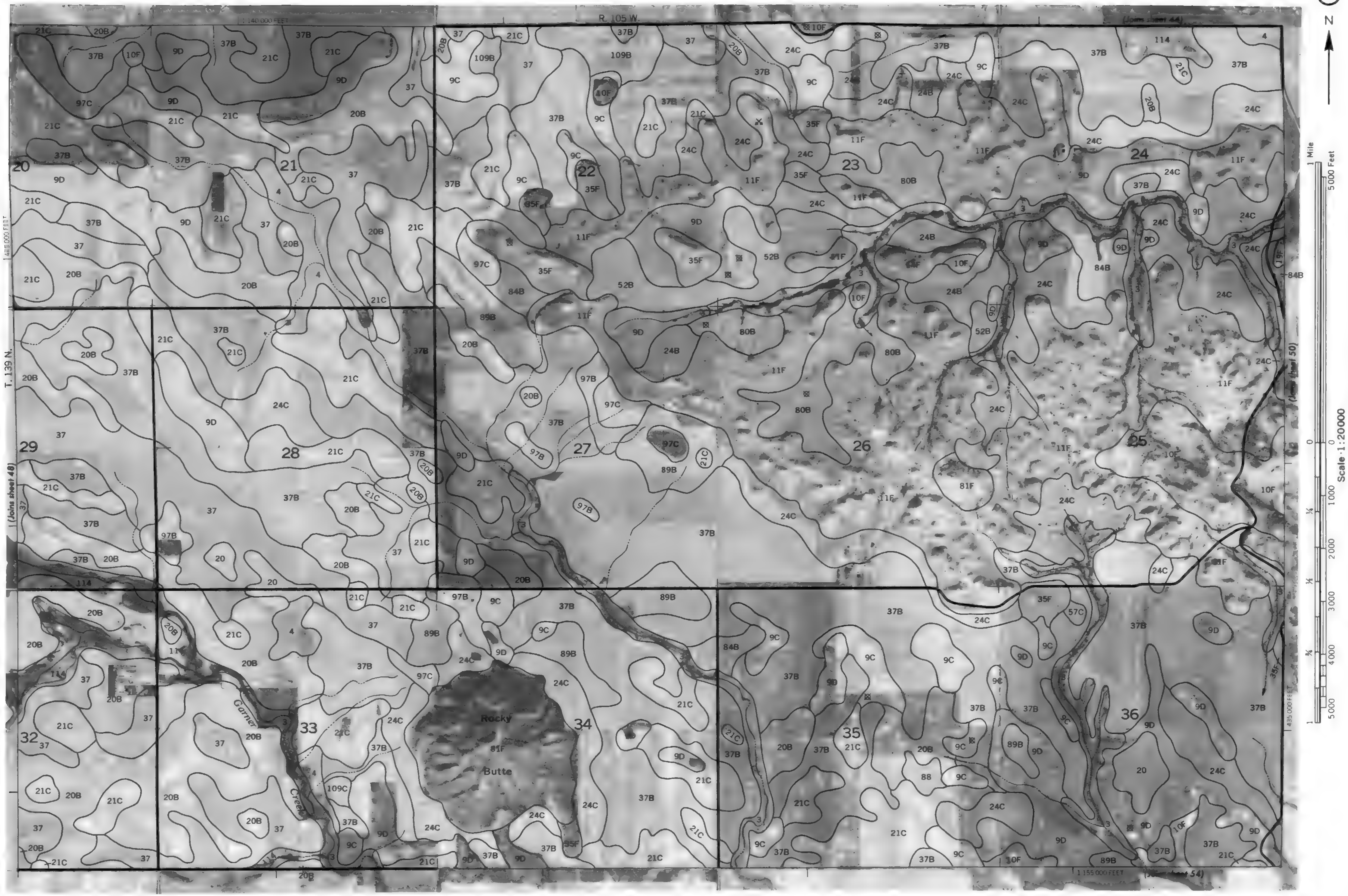


GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 47

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

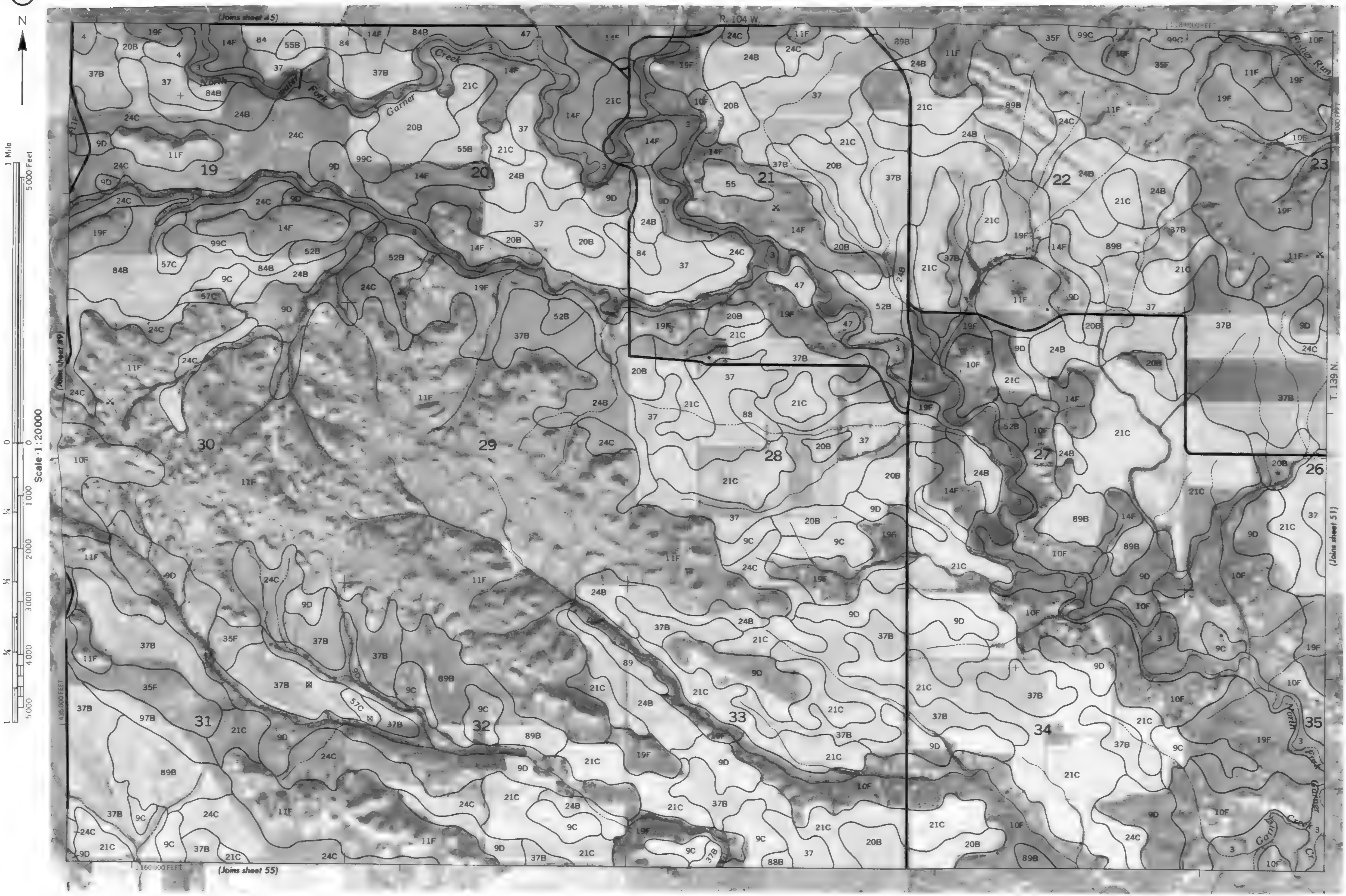


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



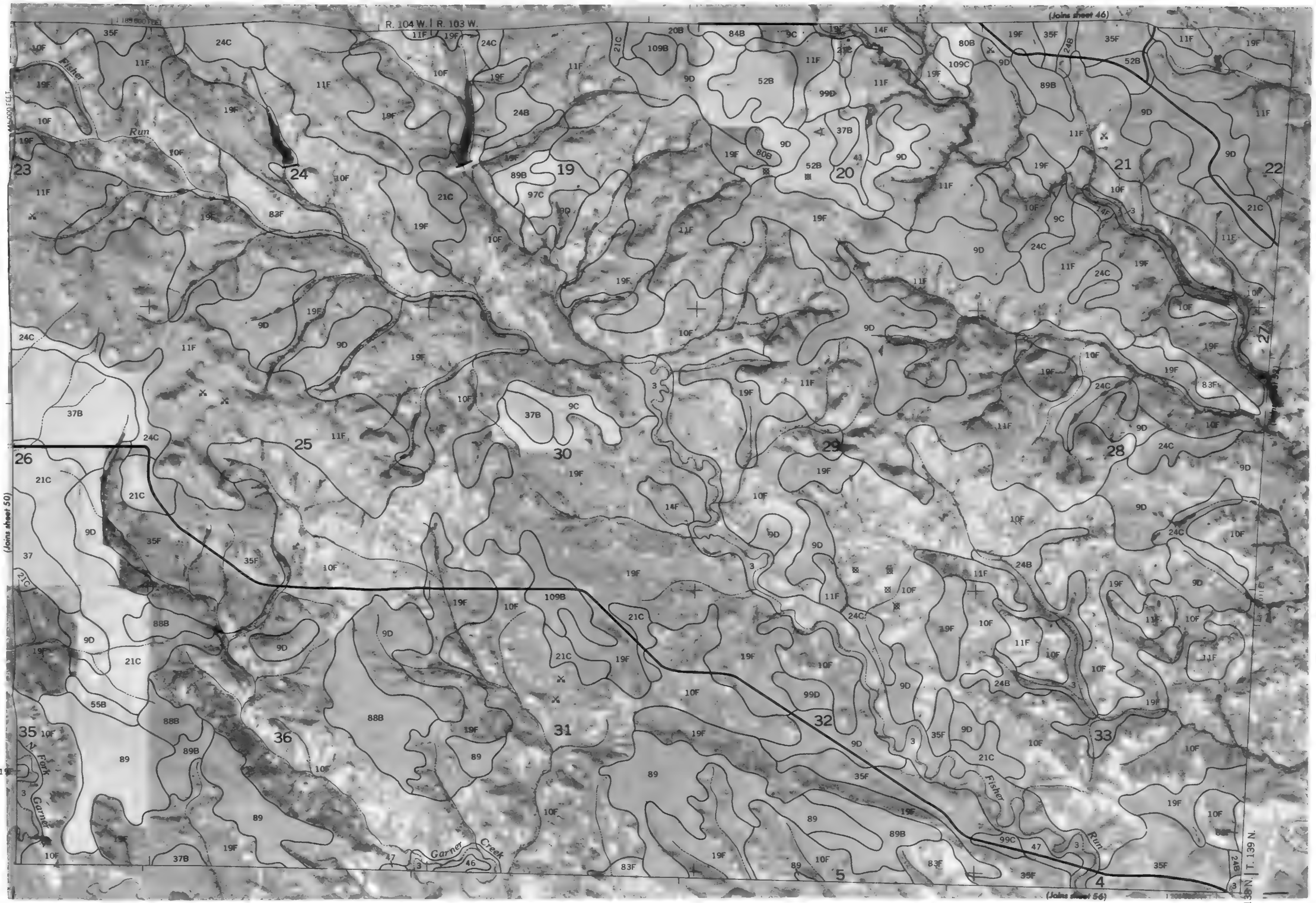
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 49

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

51

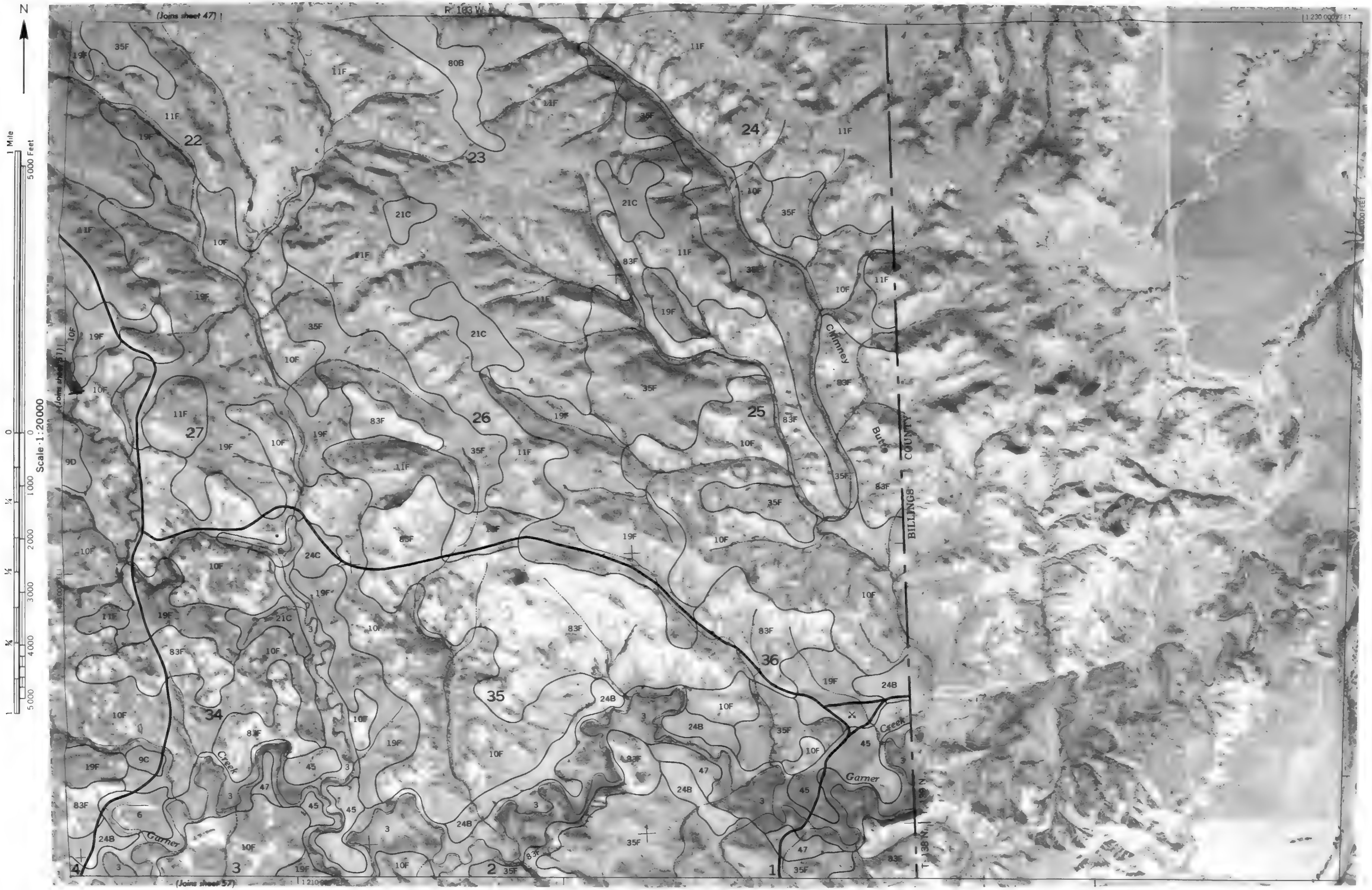


N

1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
Scale 1:20000

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 51

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

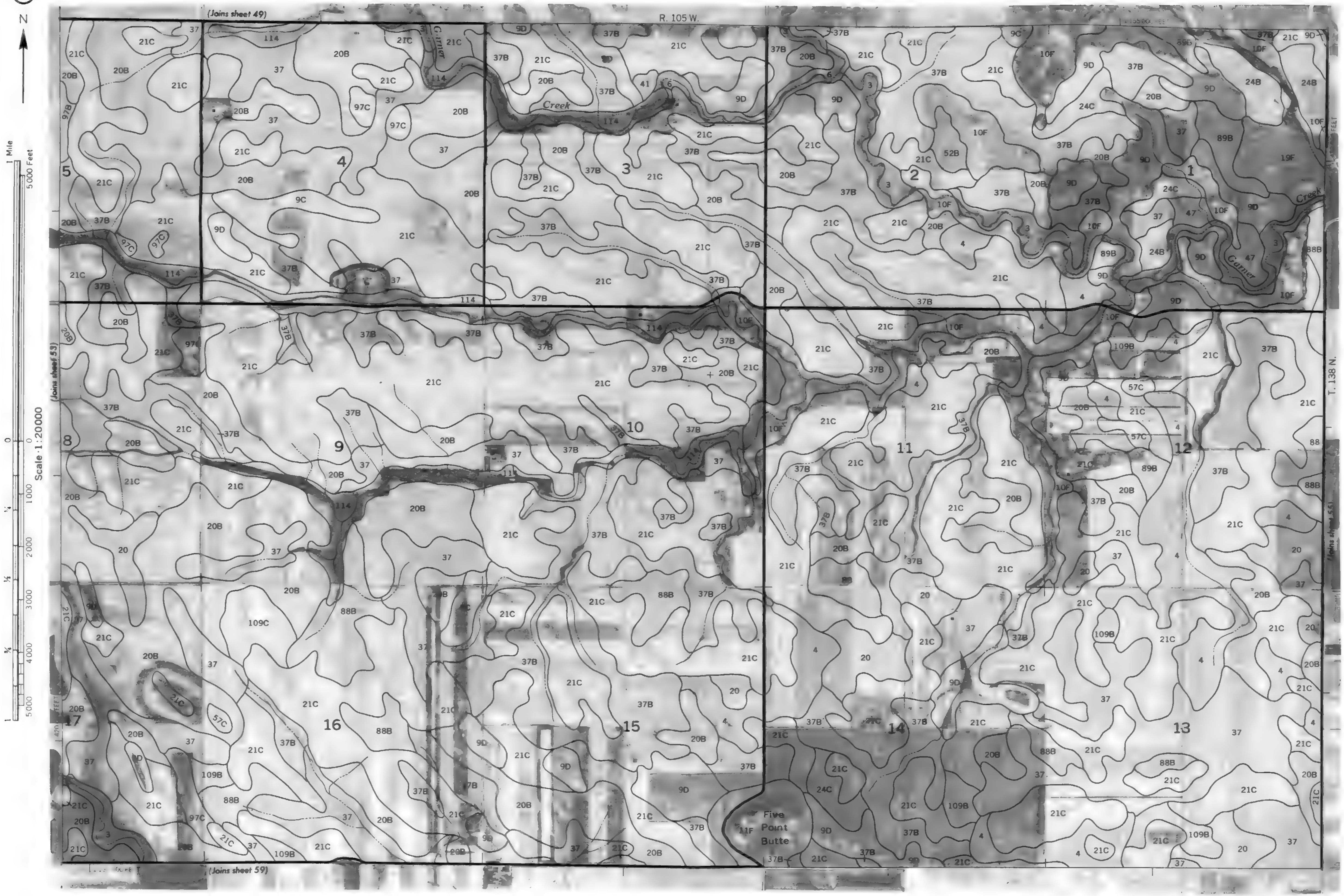


This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 52

GOLDEN VALLEY COUNTY NORTH DAKOTA NO. 53

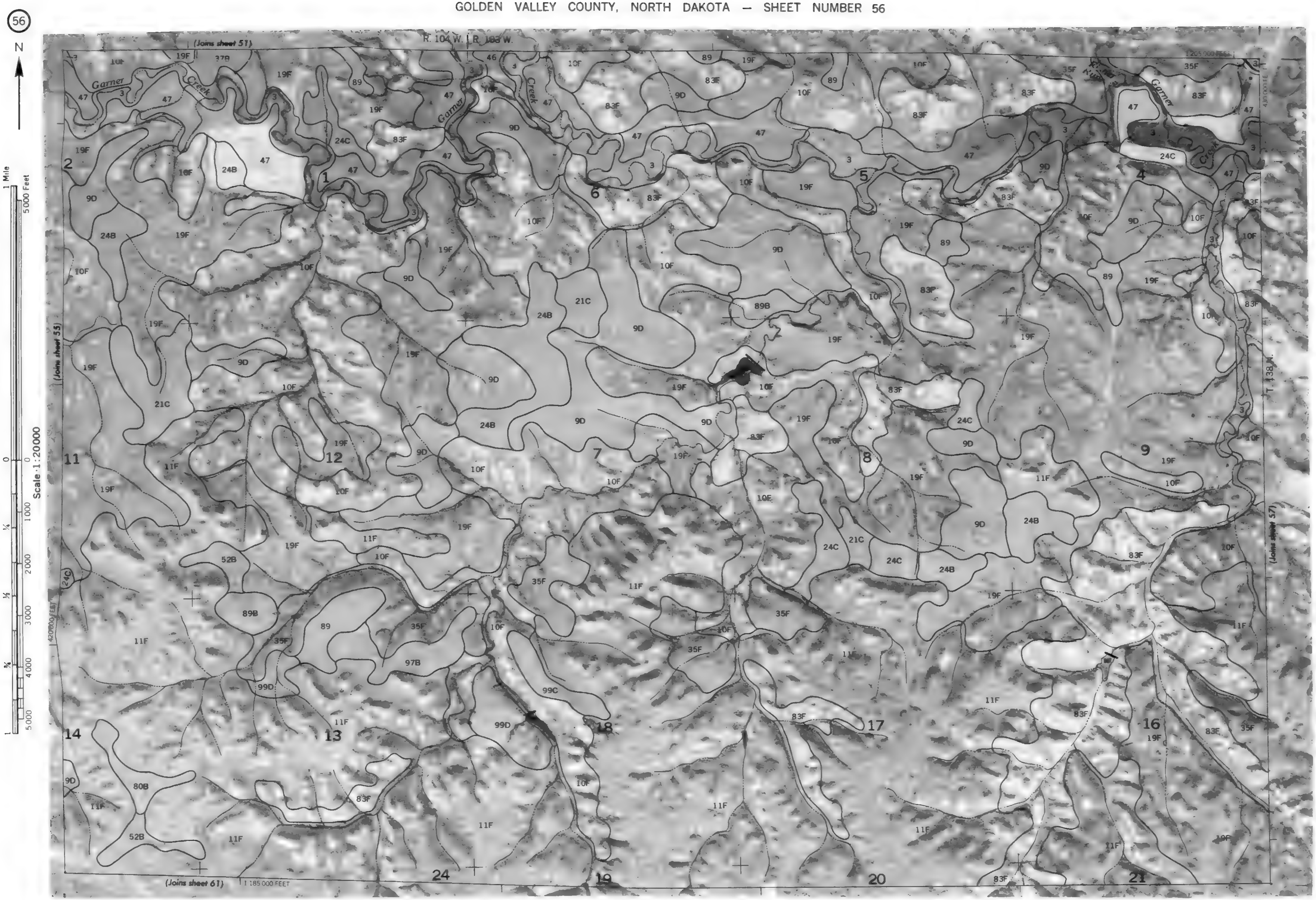
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 55

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

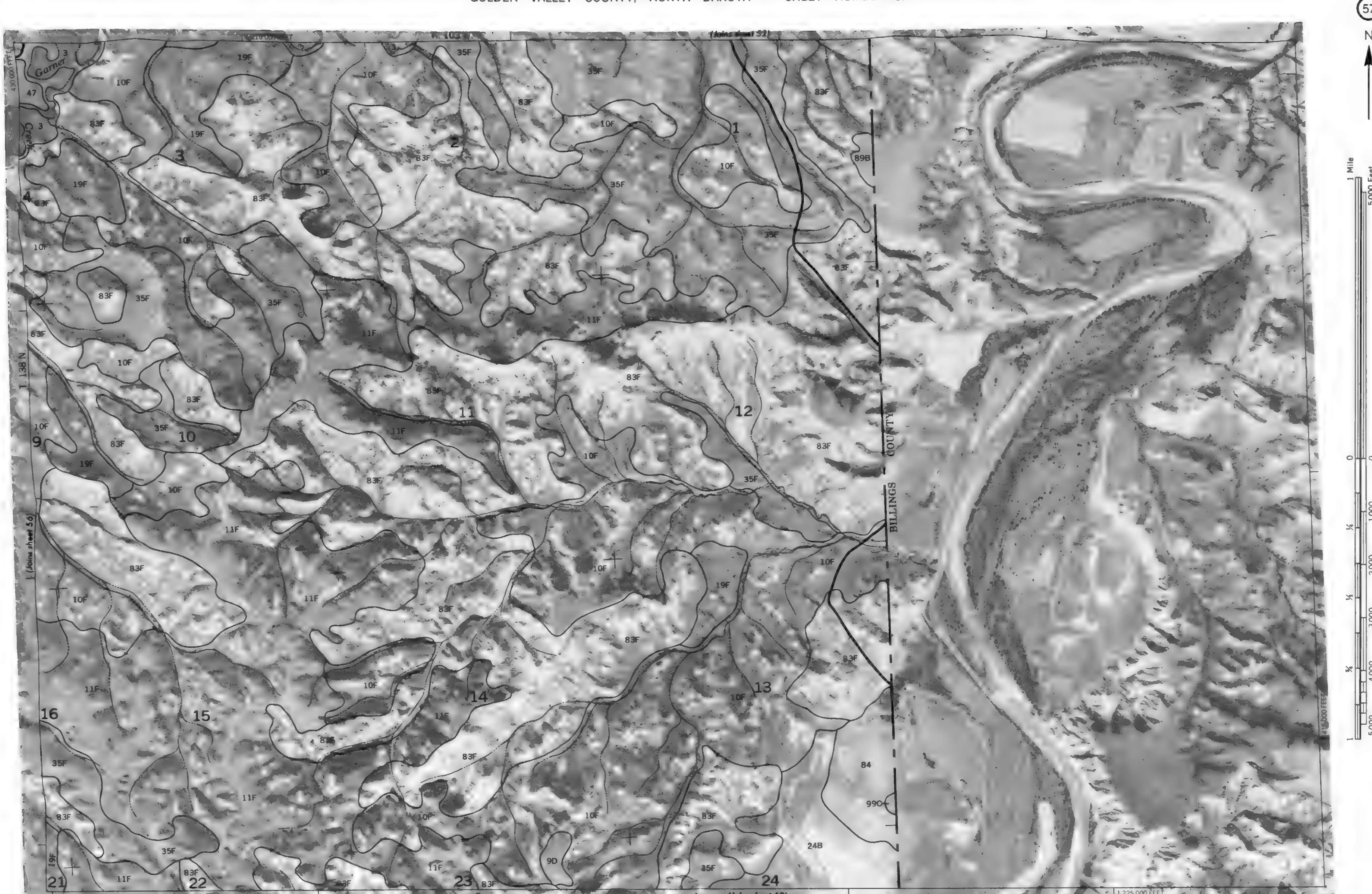


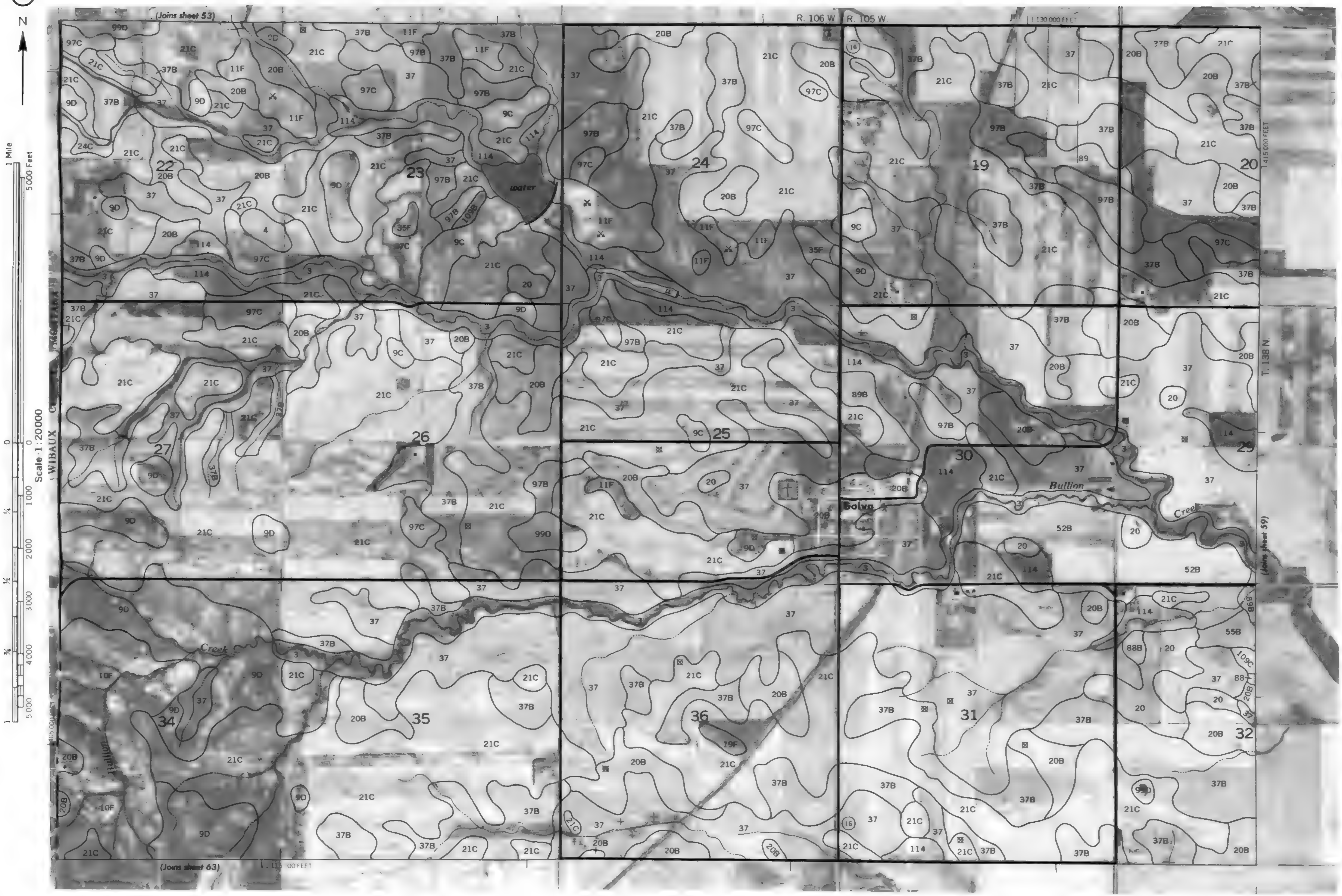
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 56

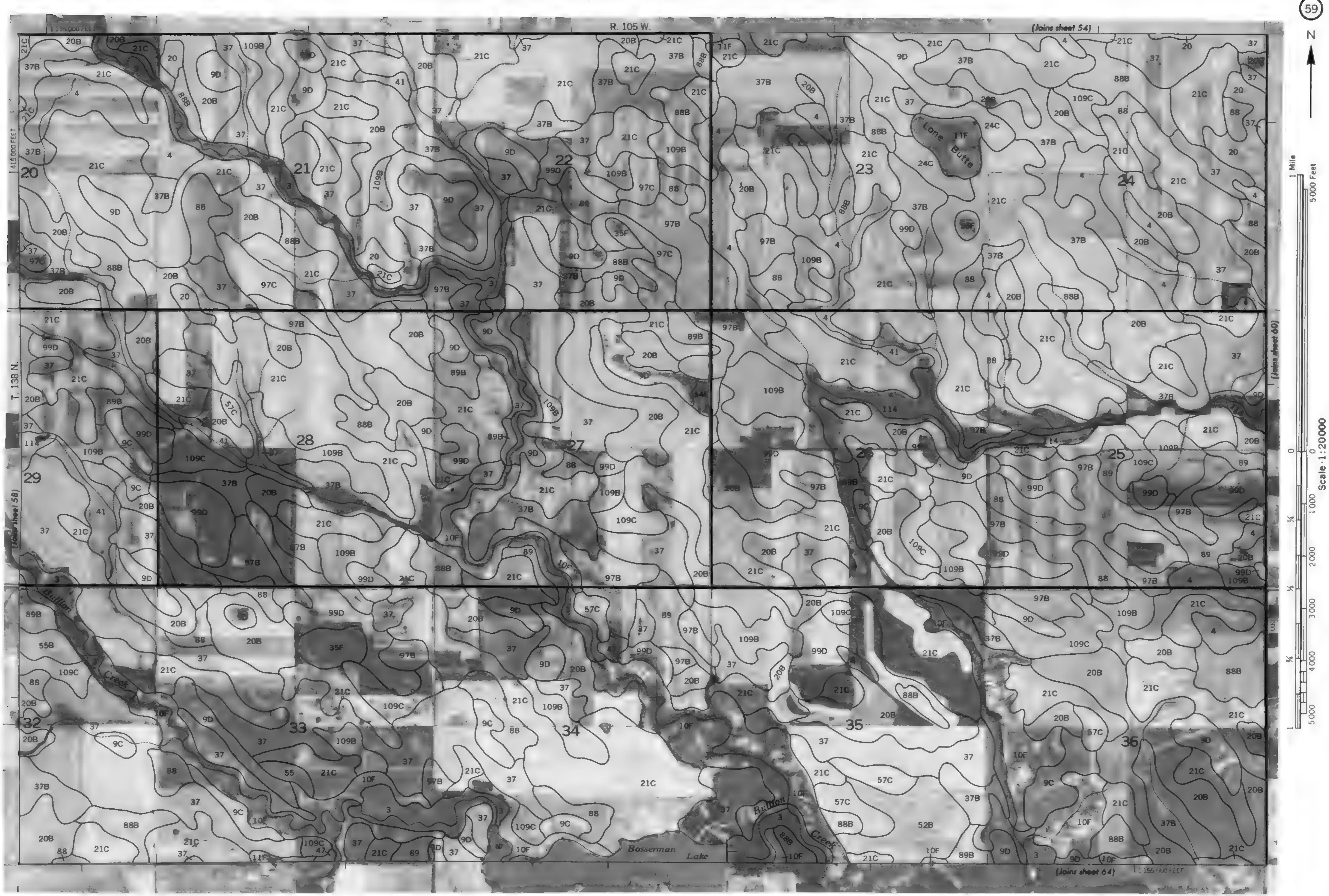
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 57

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



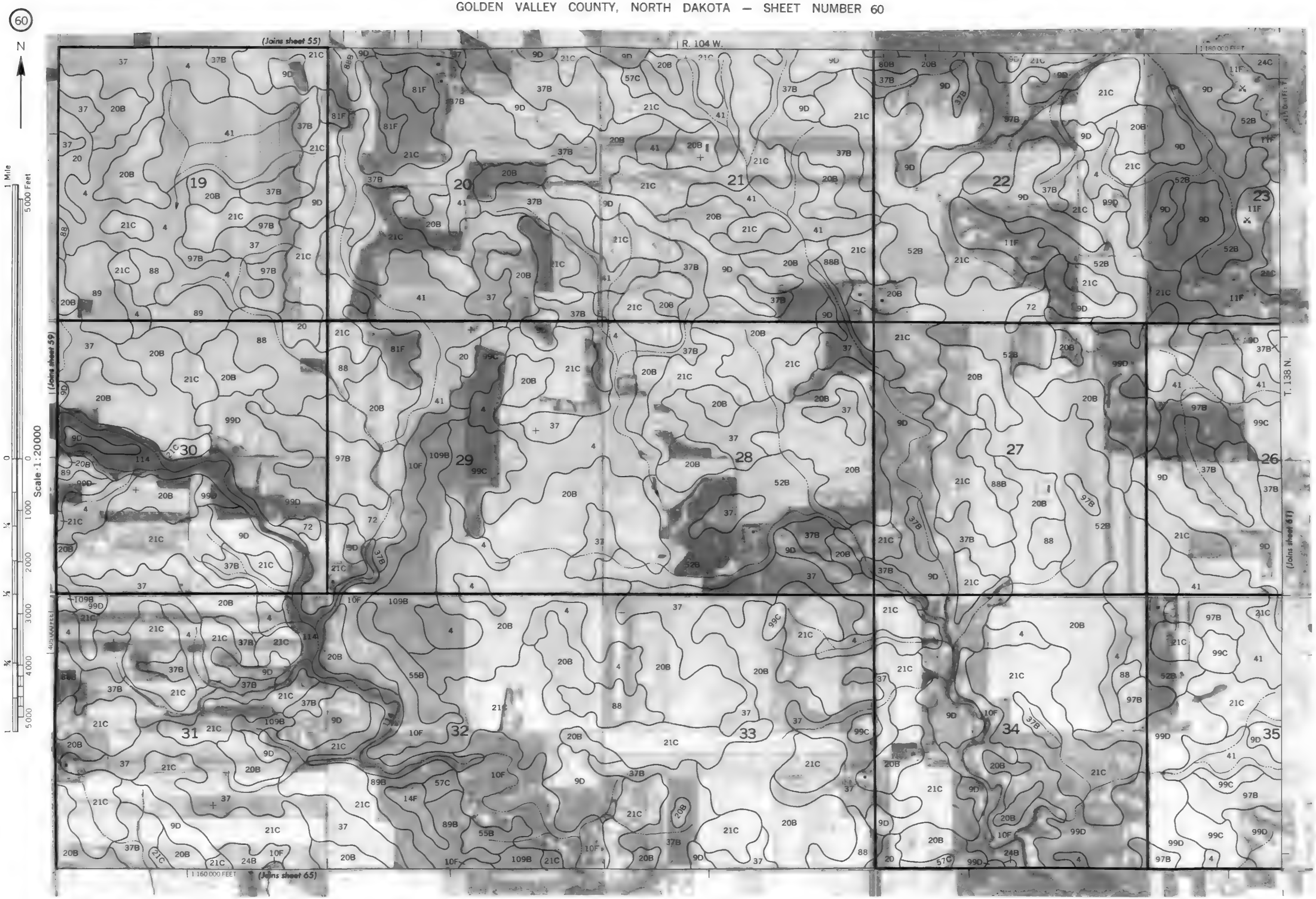


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



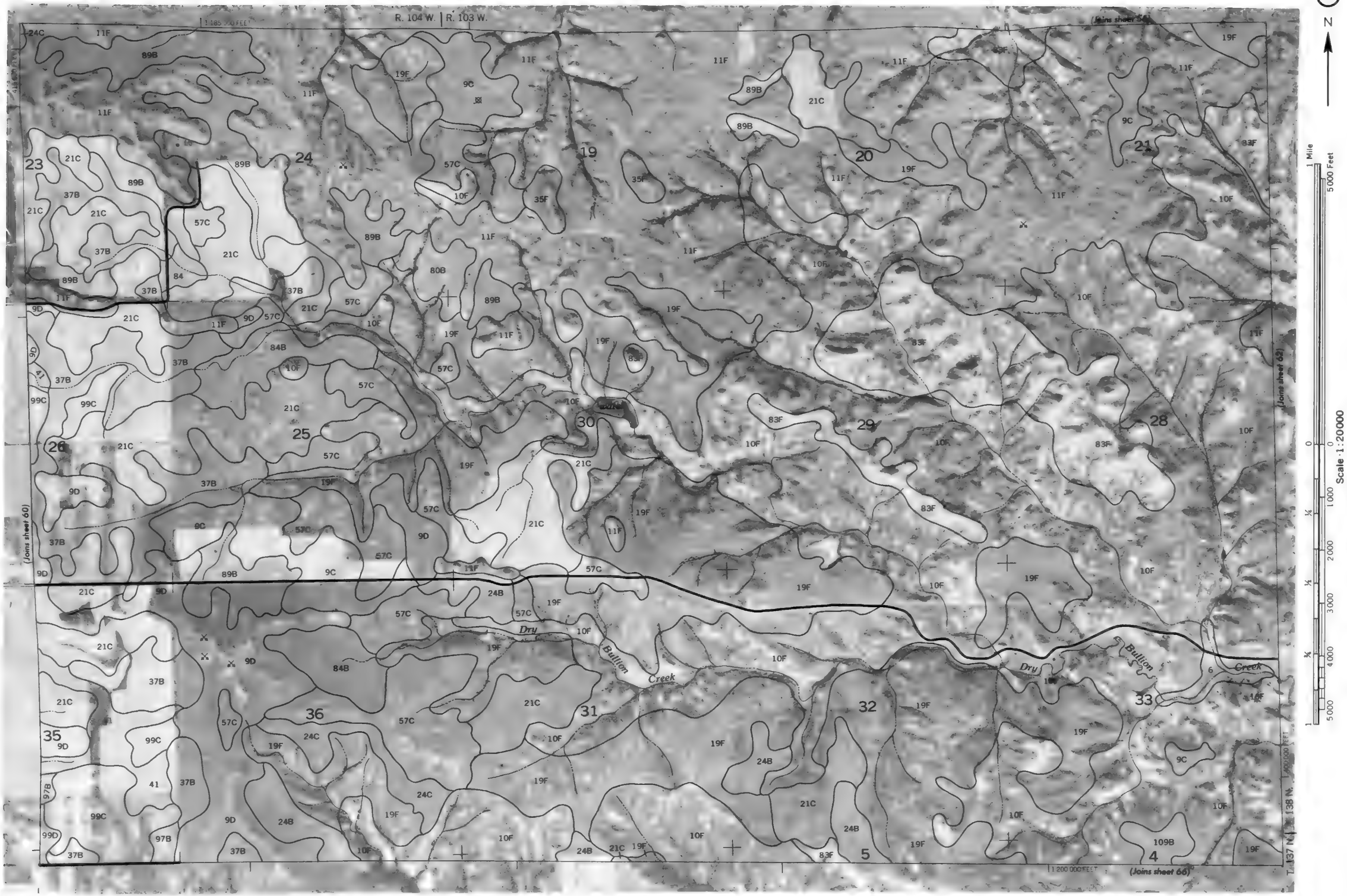
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 59

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 60

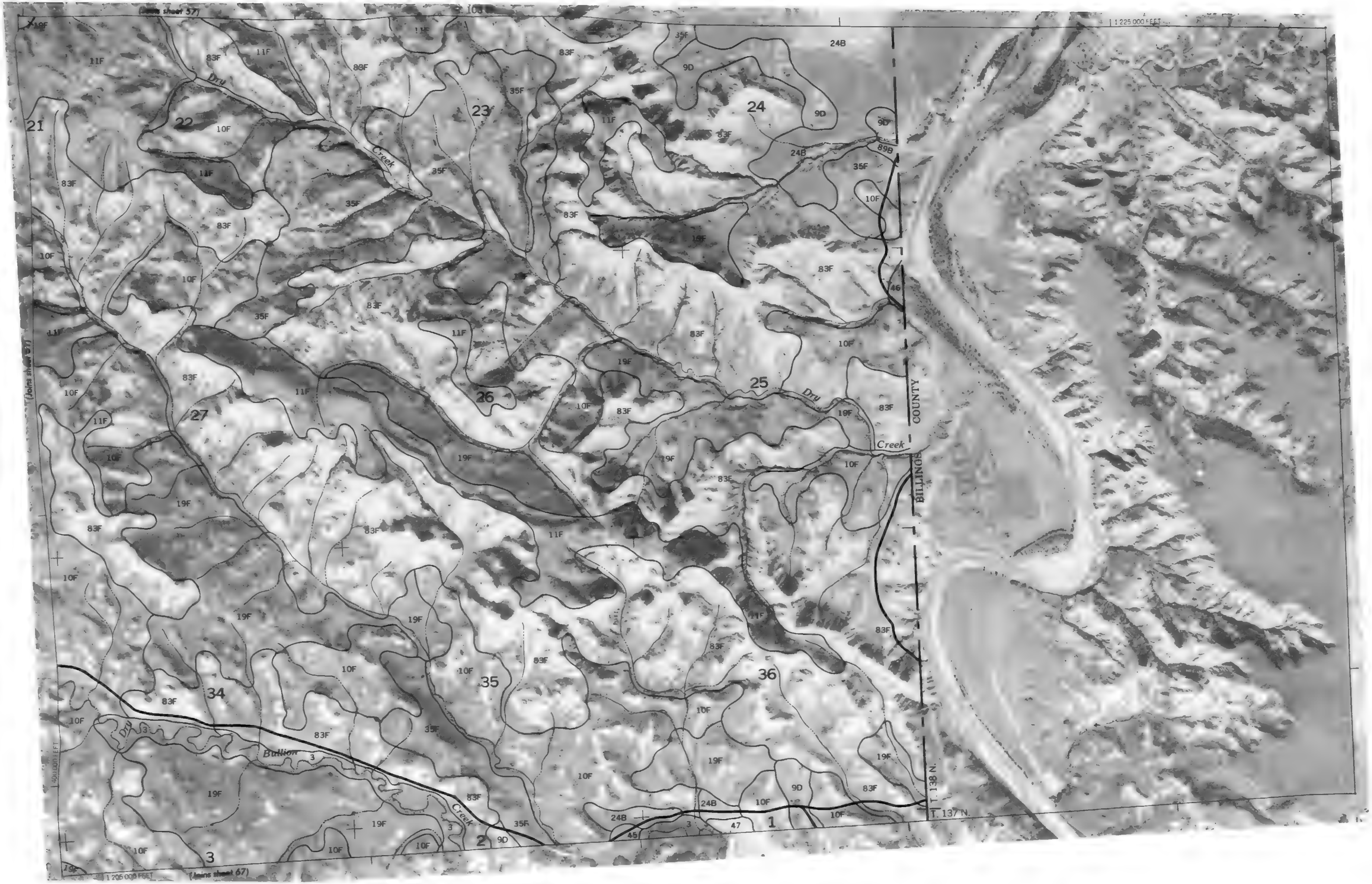


GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 61

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

1 Mile
5 000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000



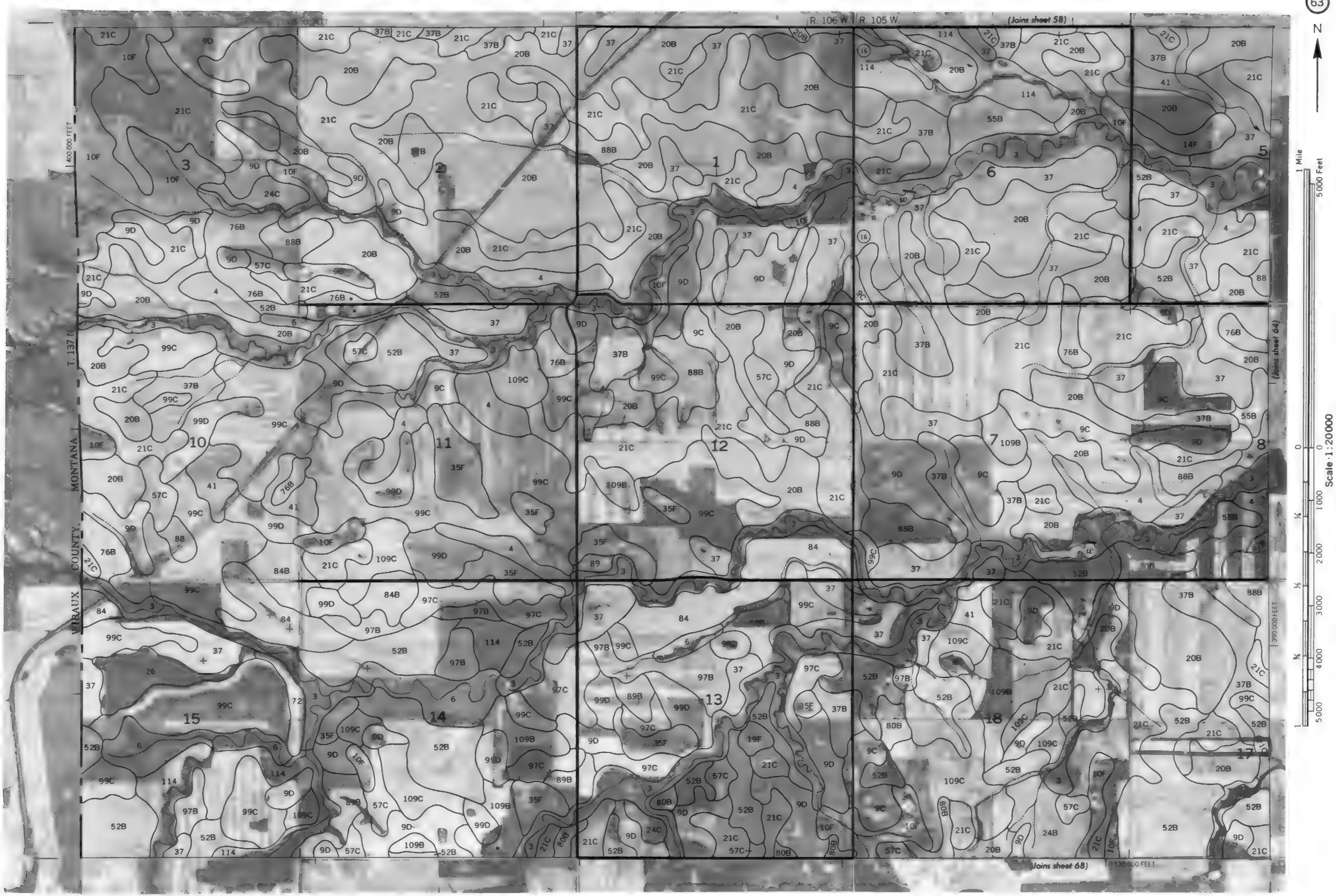
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

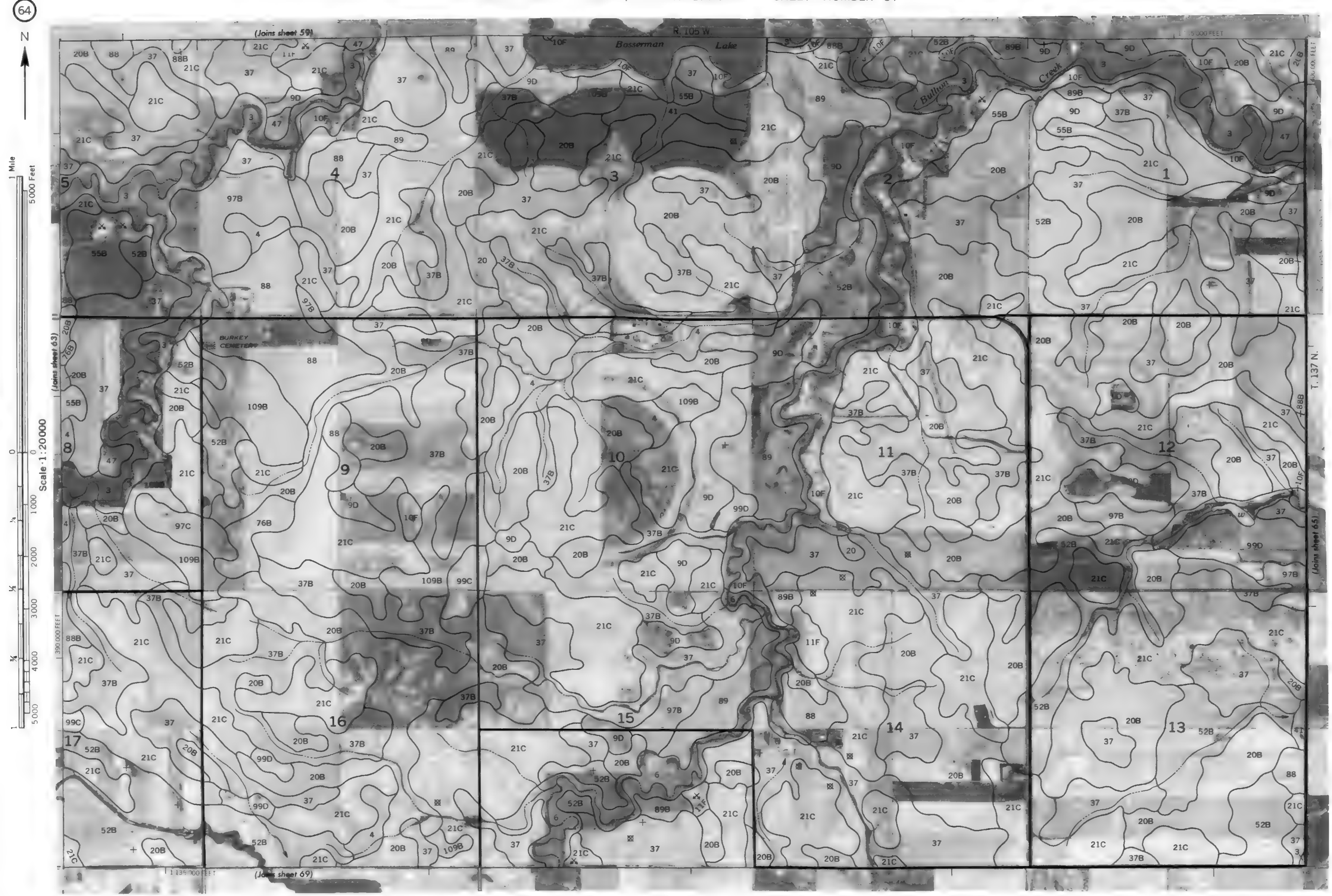
GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 62

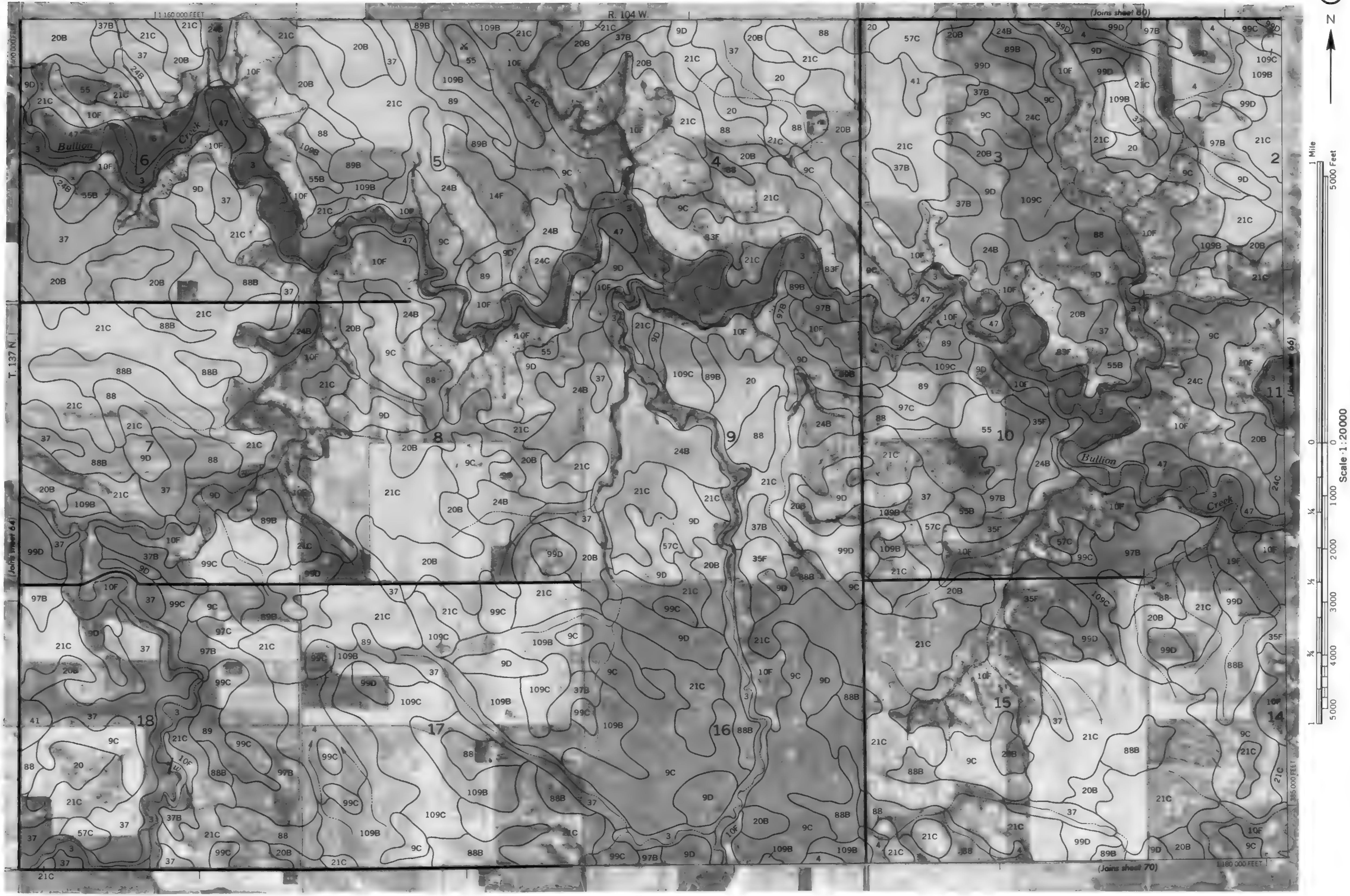
63

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 63

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



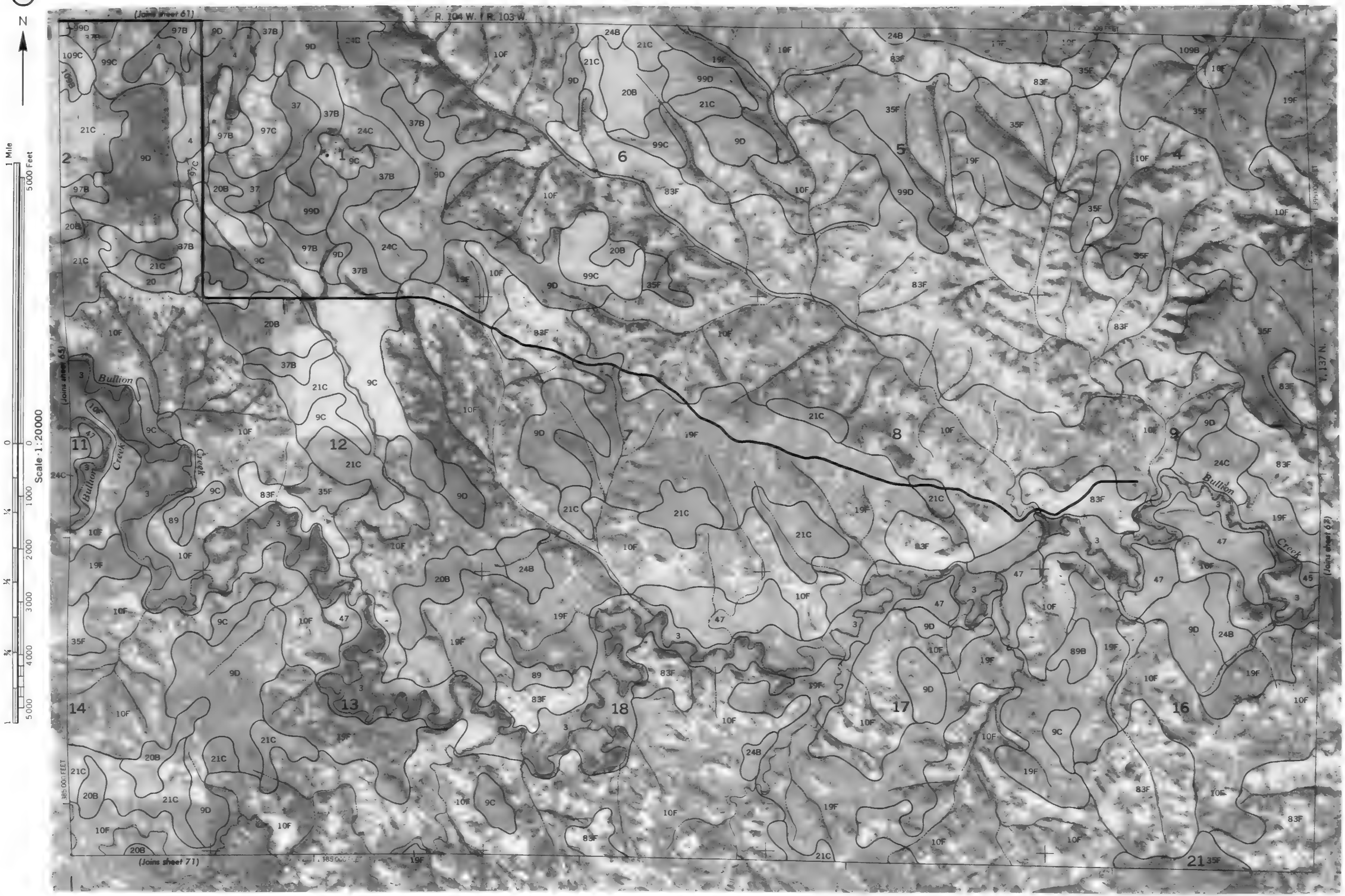

64
N
(Joins sheet 59)
R. 105 W.
Bosserman Lake
Bullion Creek
BURKEY CEMETERY
(Joins sheet 63)
(Joins sheet 65)
(Joins sheet 69)
T. 137 N.
Scale 1:20000
1 Mile
5000 Feet
1 135 000 FEET
390 000 FEET



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 65

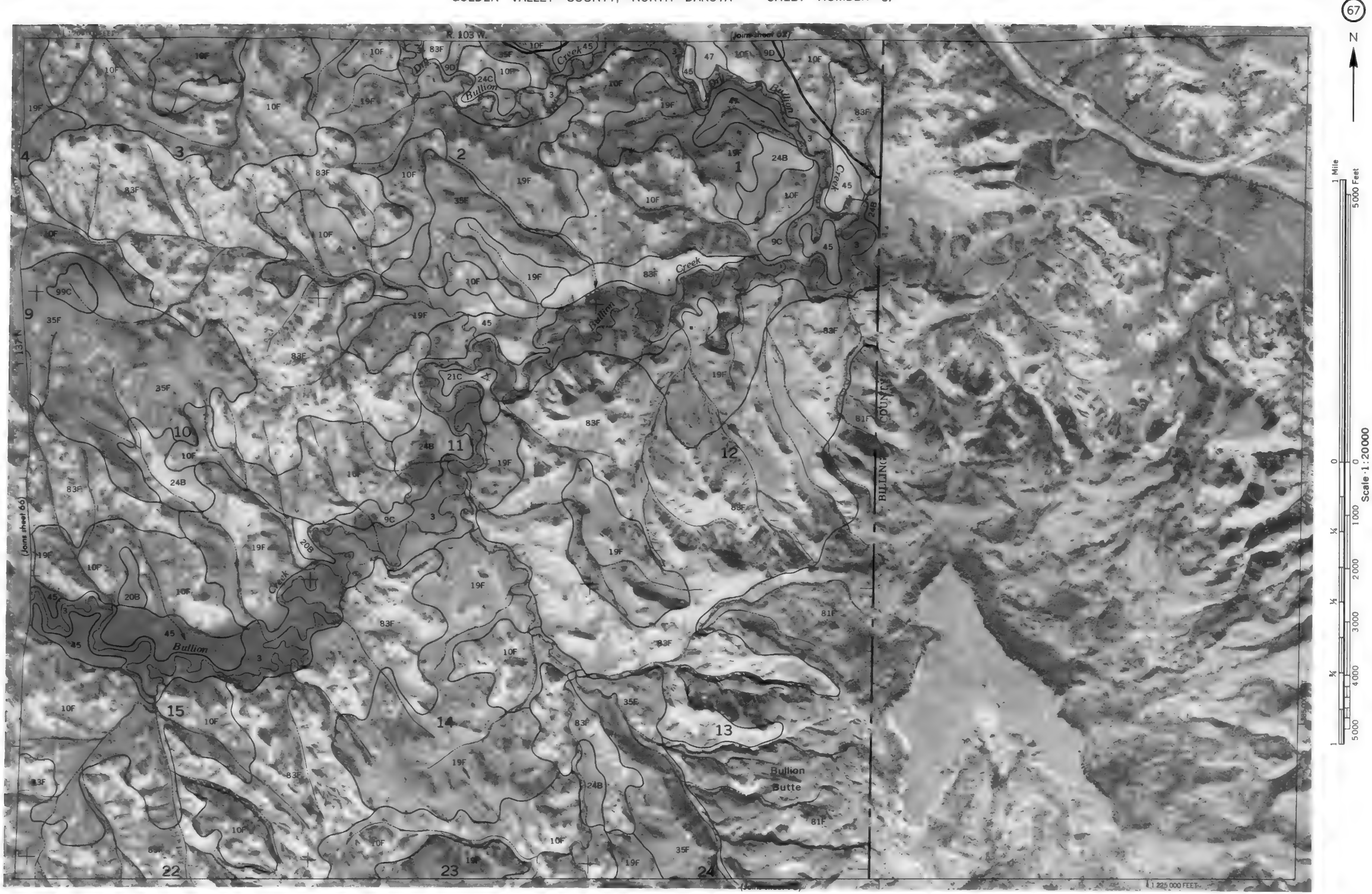
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 66



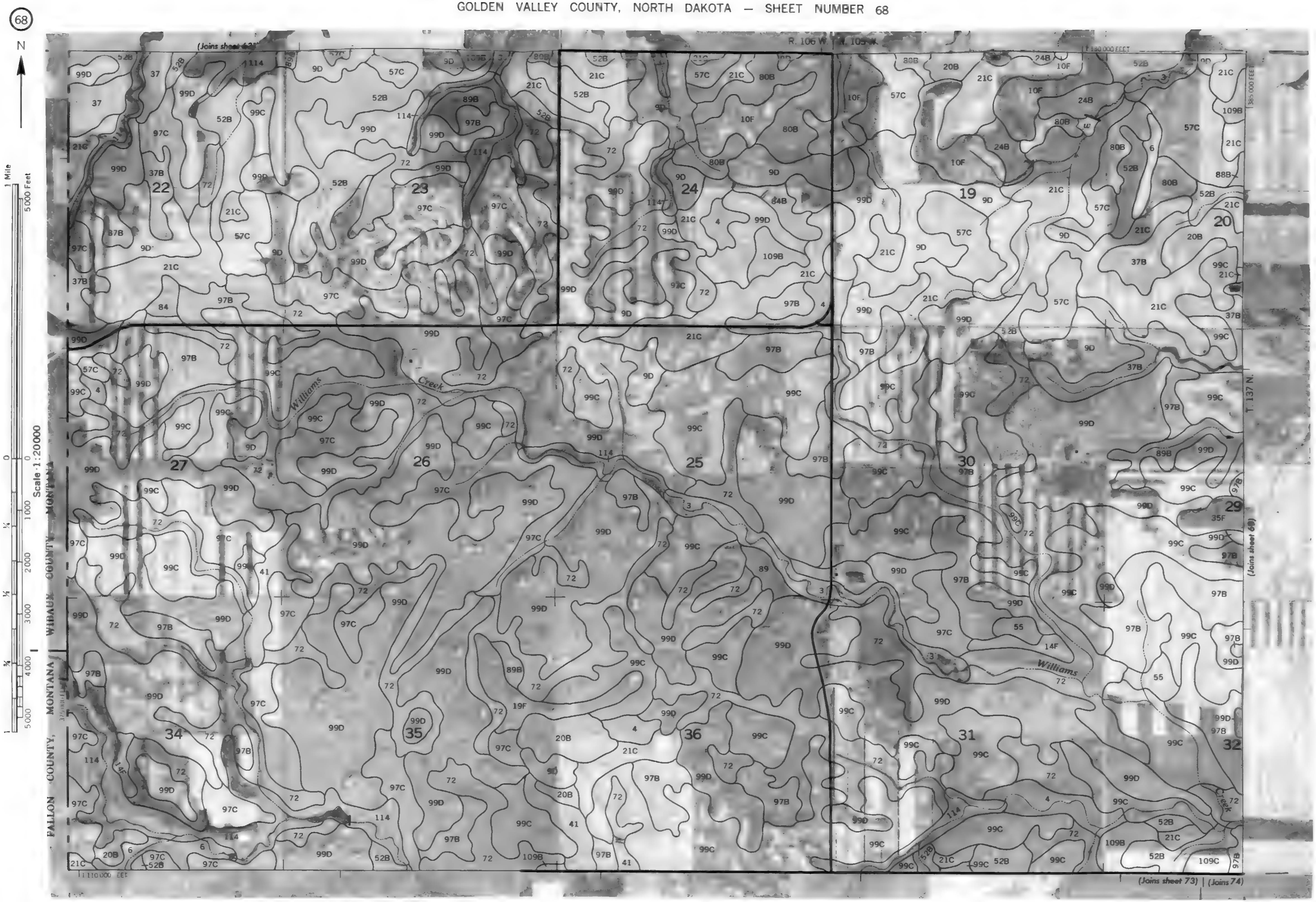
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 66



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 67

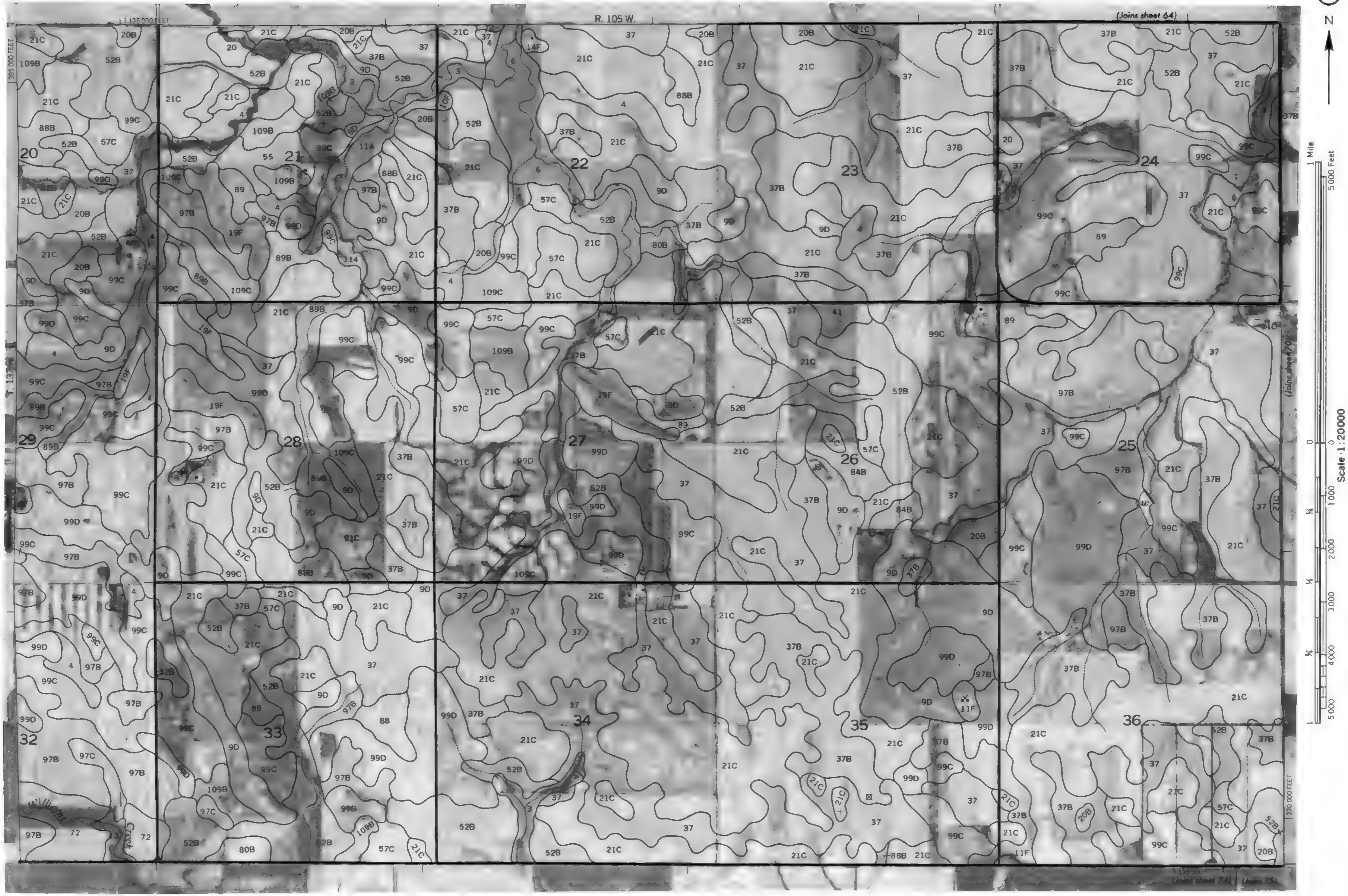
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

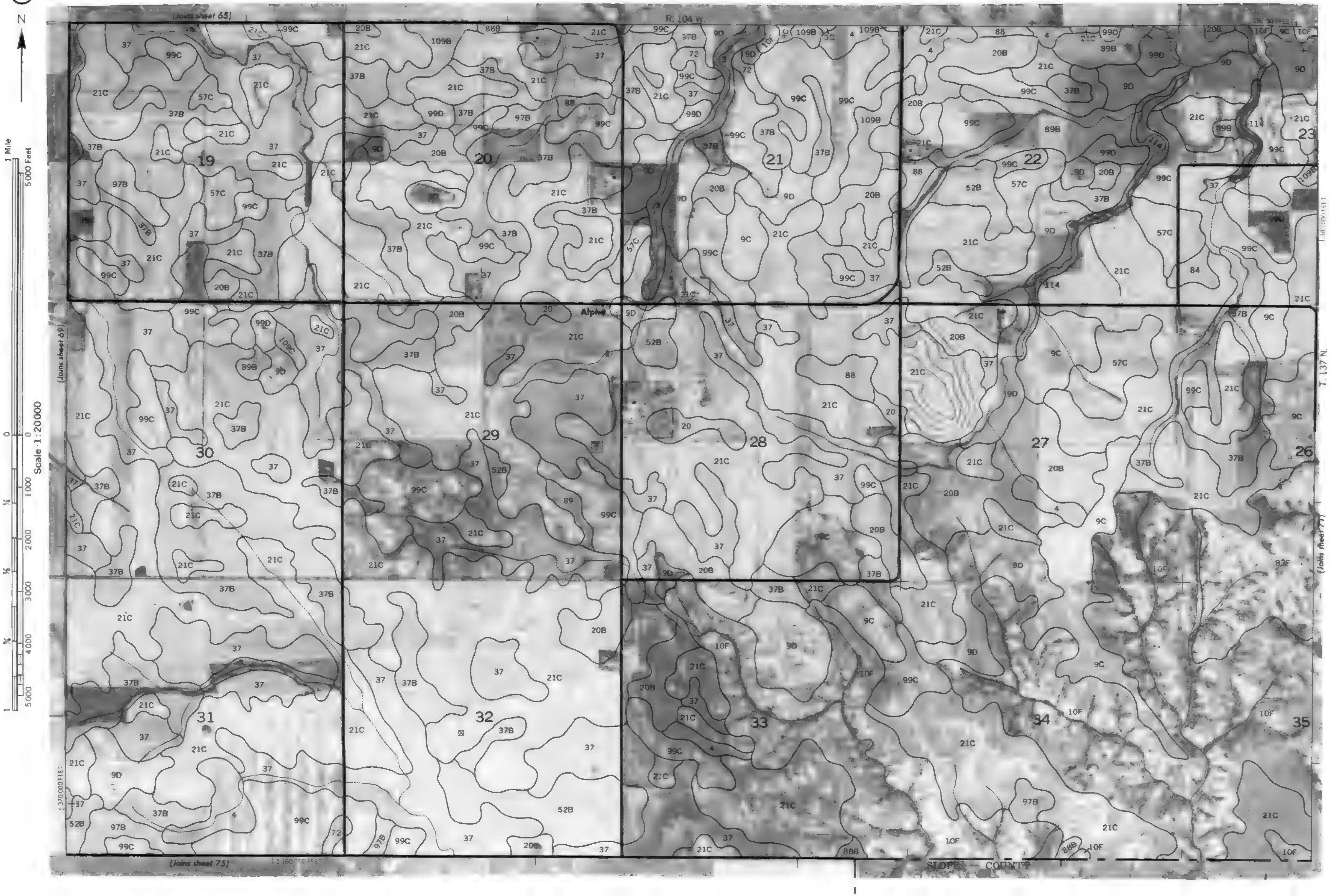


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 69

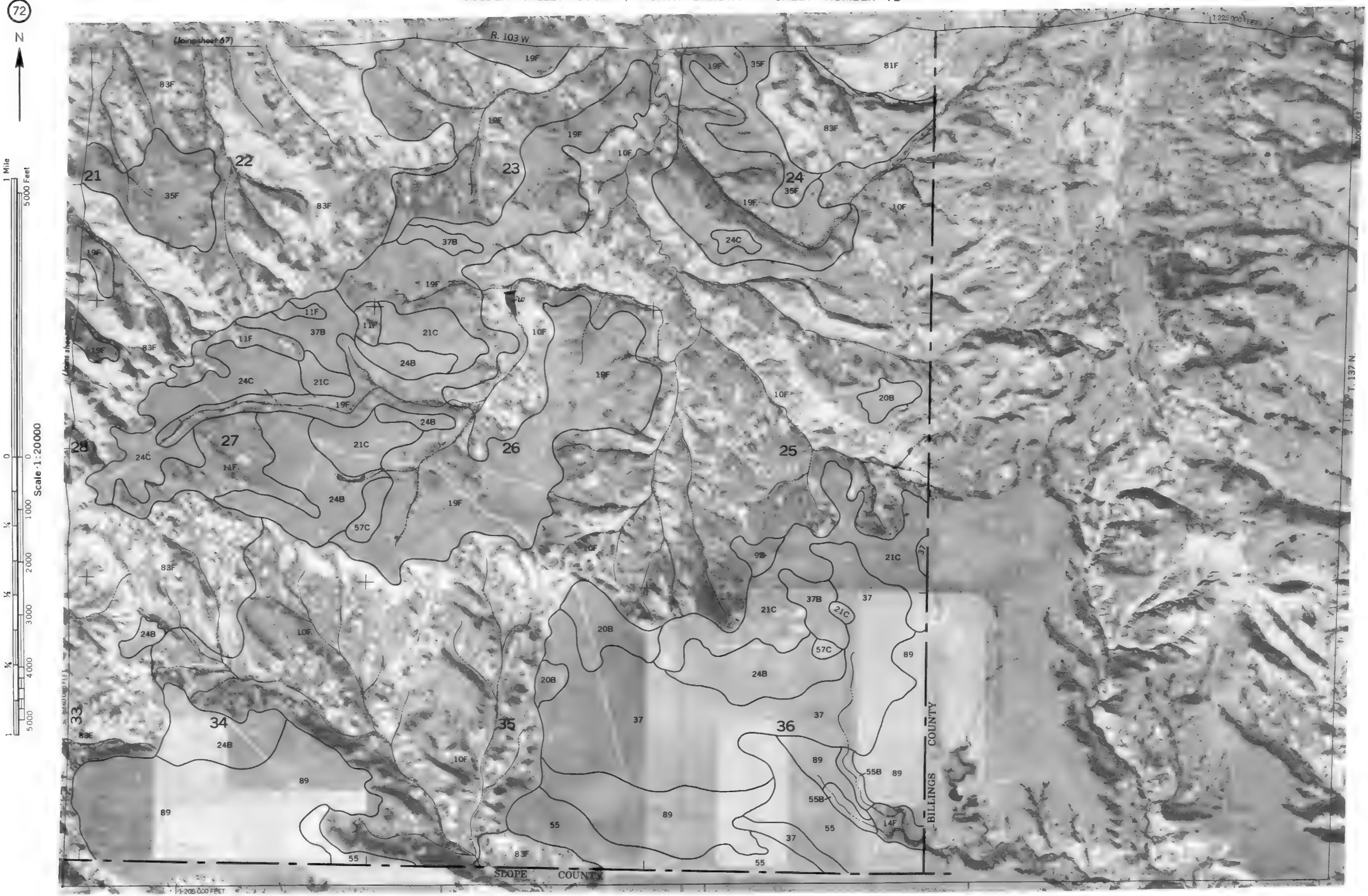
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



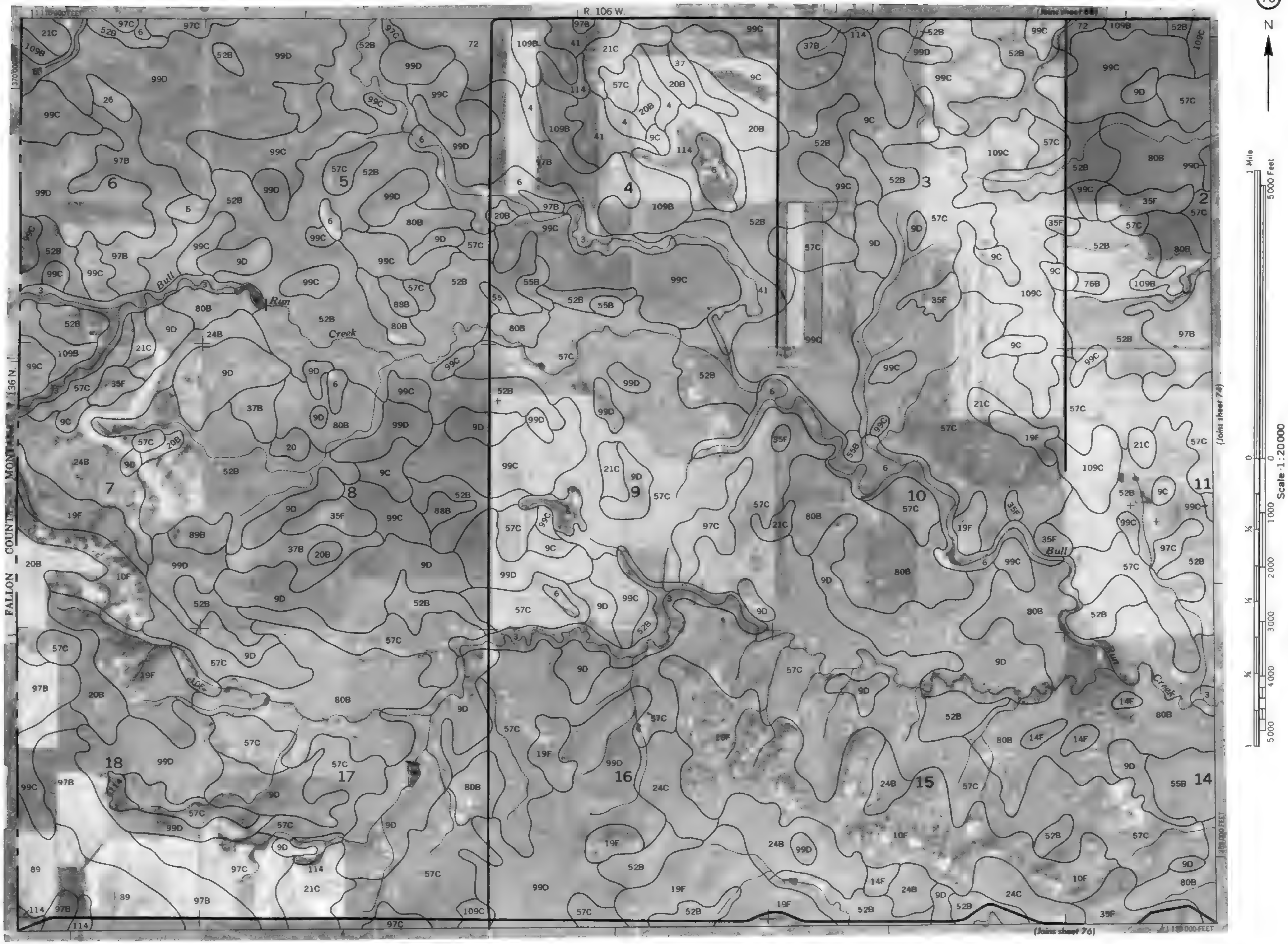

N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 65)
R. 104 W.
(Joins sheet 69)
T. 137 N.
(Joins sheet 77)
(Joins sheet 75)
Alpha
SLOPE COUNTY
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 71

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

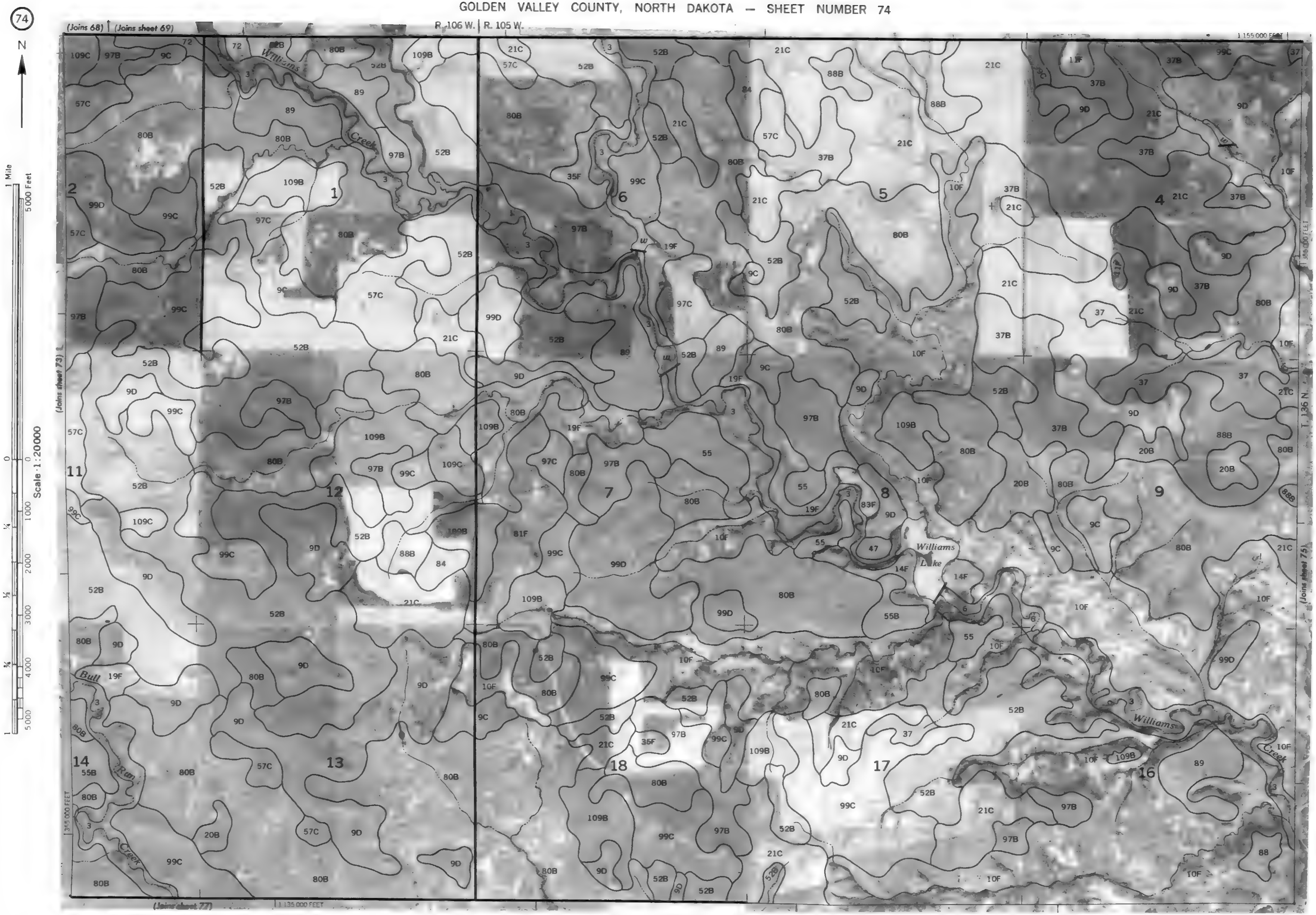


This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 73

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

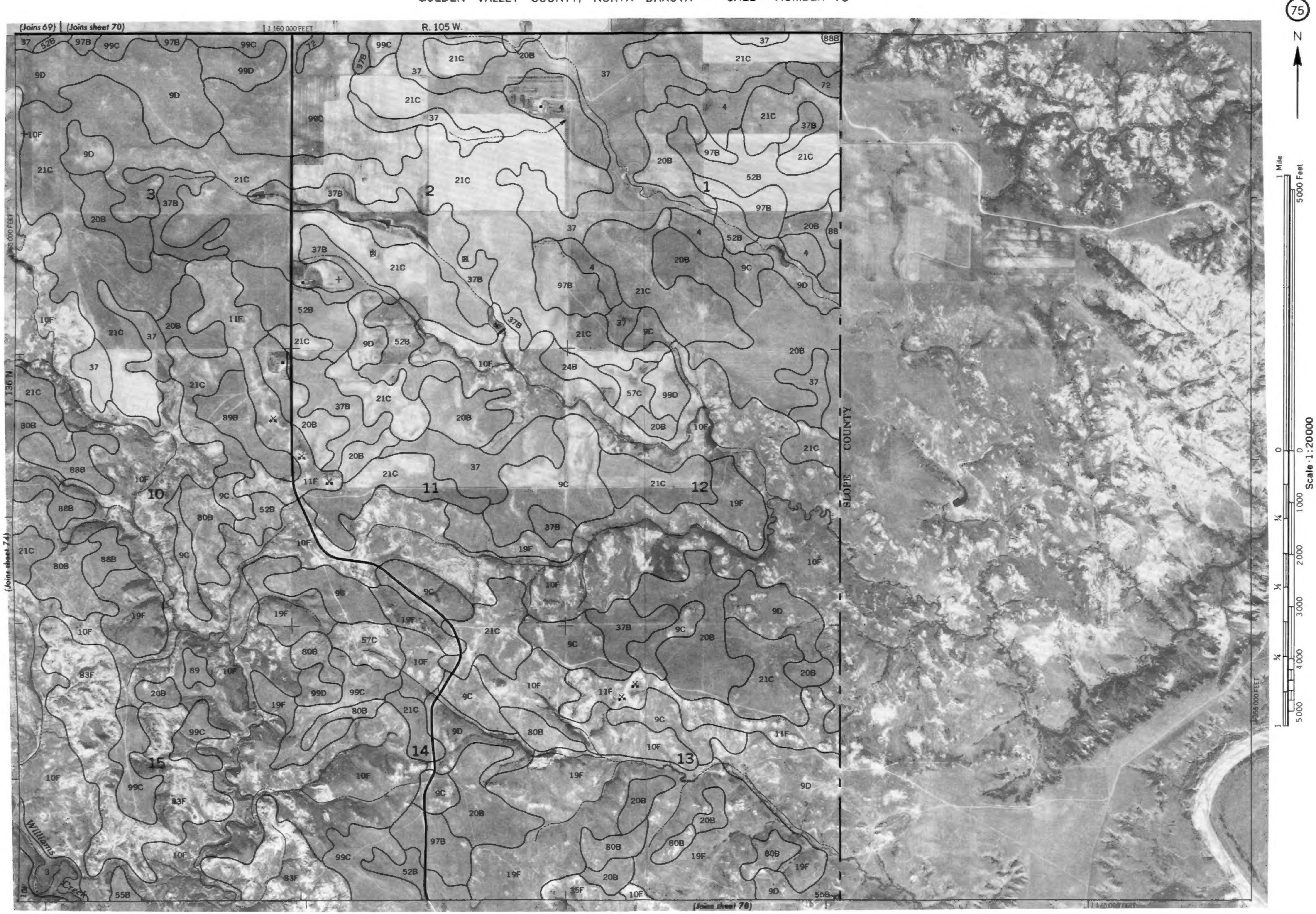


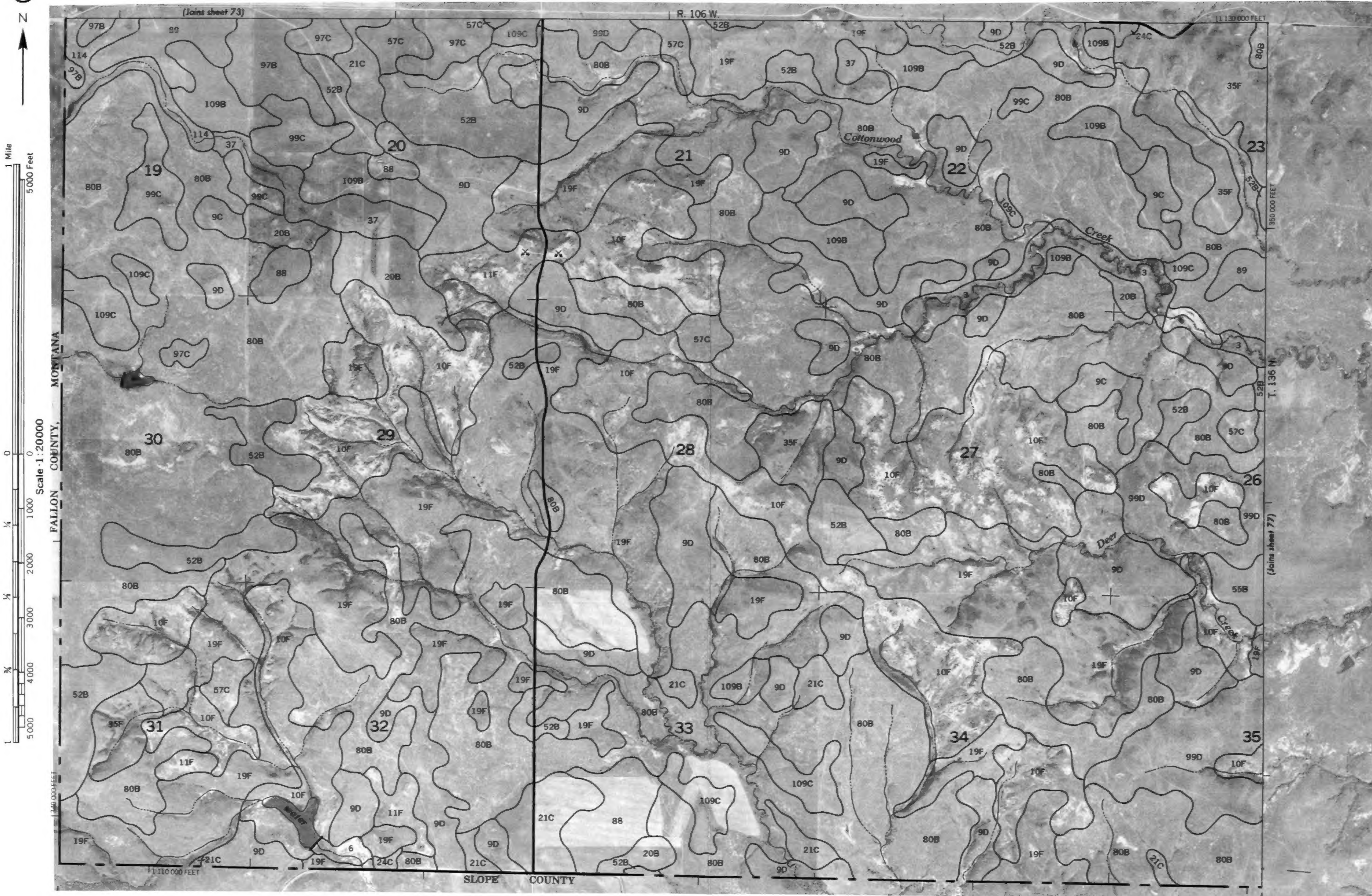
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 74

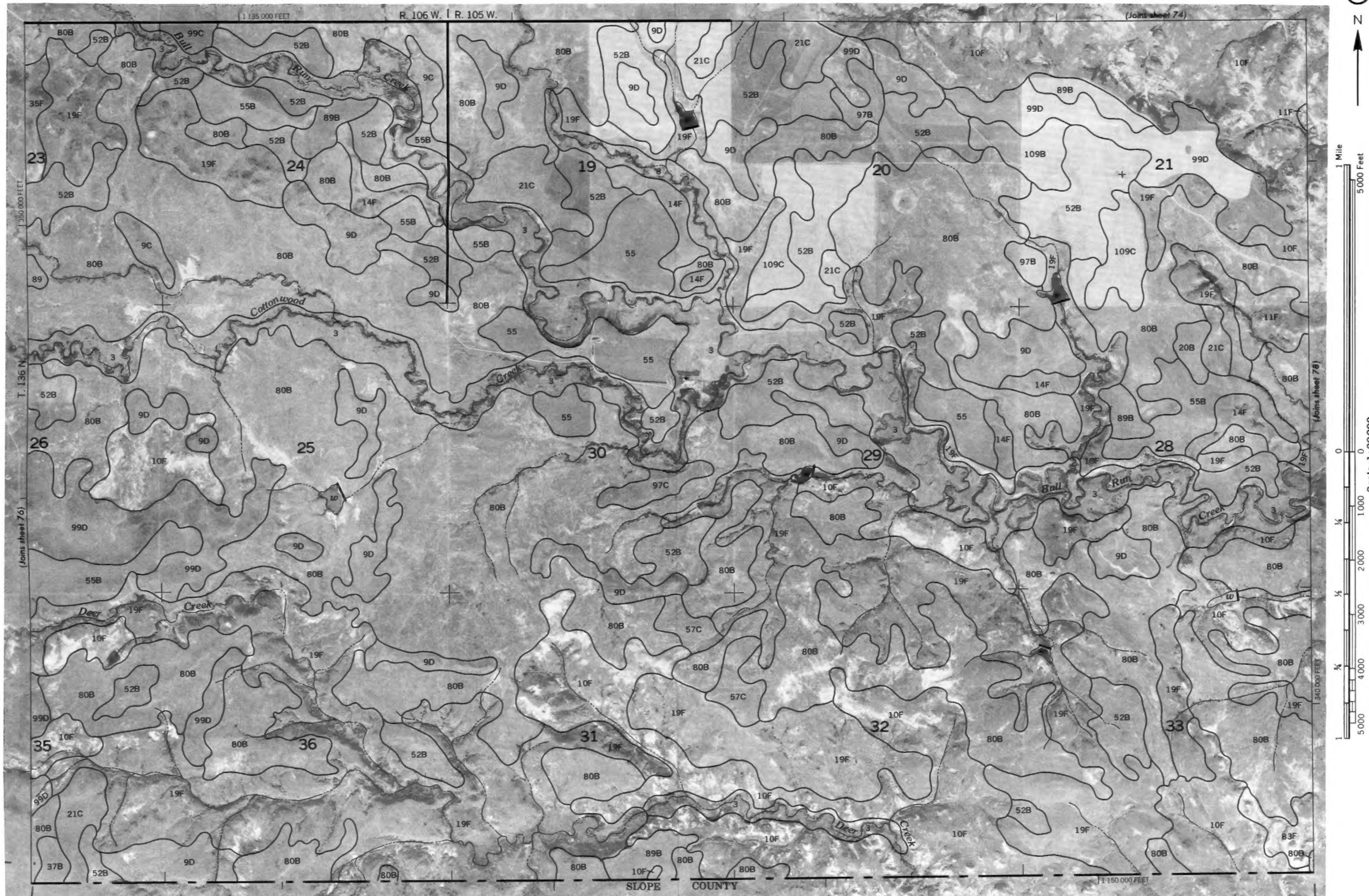
GOLDEN VALLEY COUNTY NORTH DAKOTA NO. 75

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





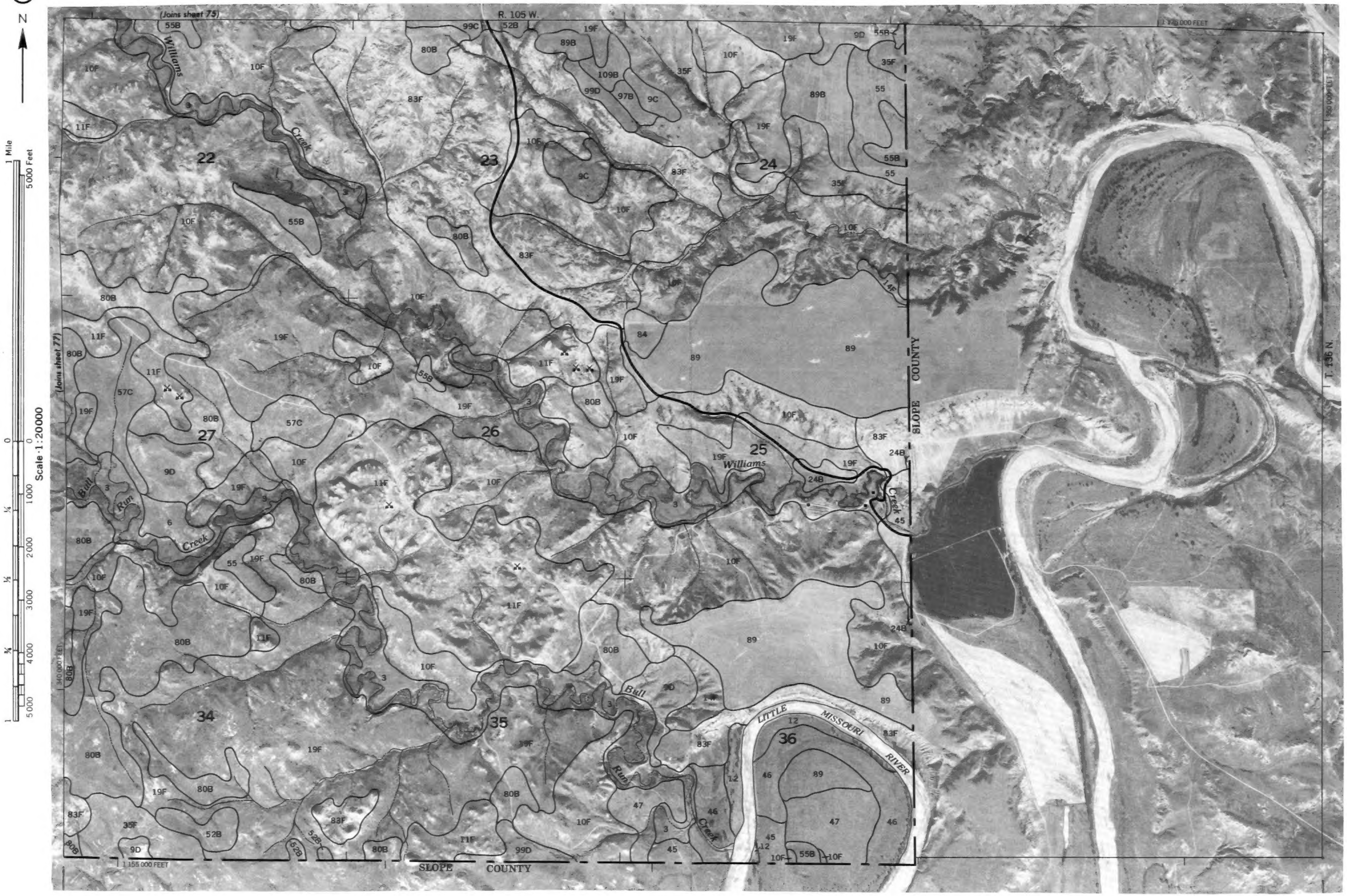
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



GOLDEN VALLEY COUNTY, NORTH DAKOTA NO. 77

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

GOLDEN VALLEY COUNTY, NORTH DAKOTA — SHEET NUMBER 78



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.